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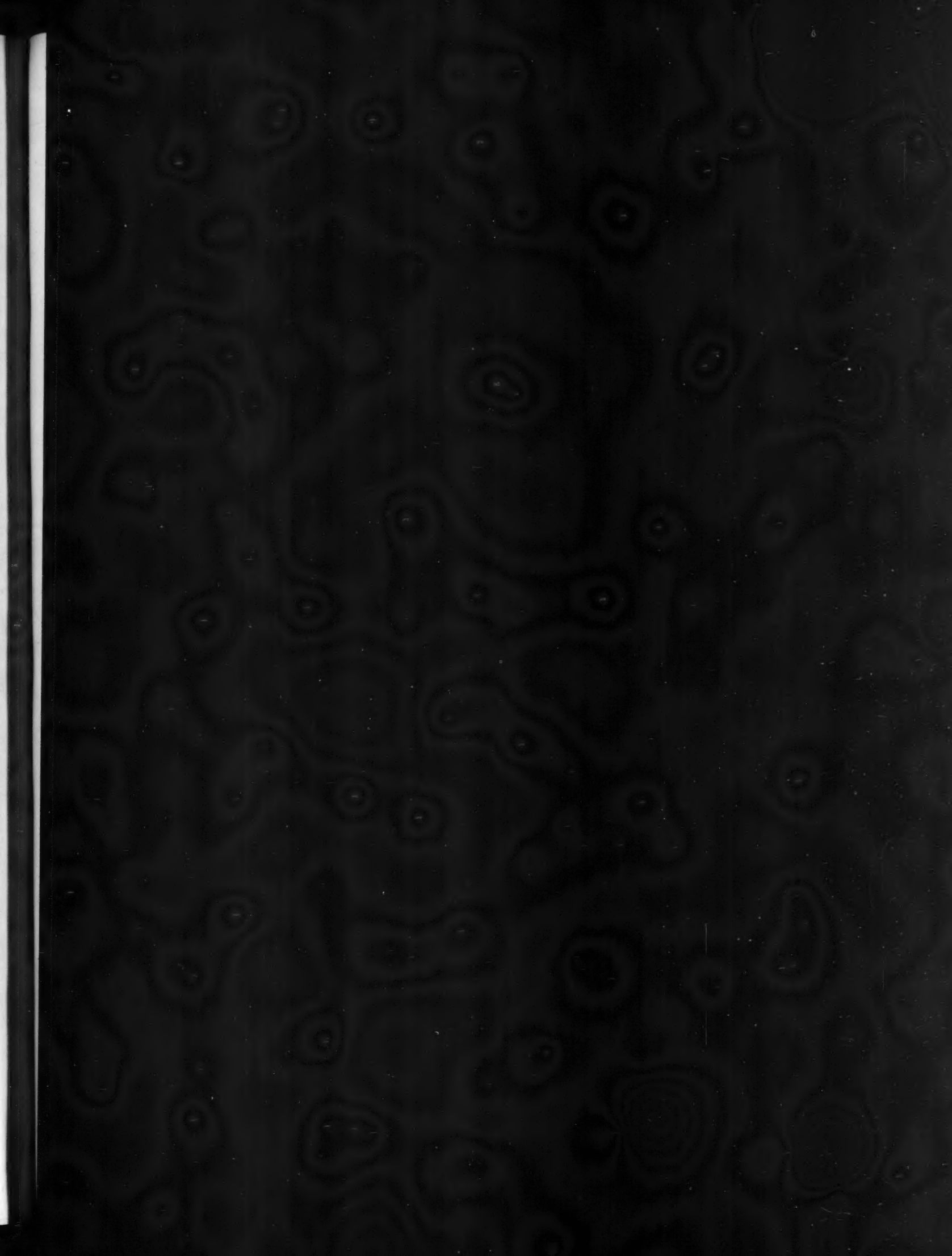

THE

Journal of Electricity, Power and Gas

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The Engineers' Architects' and Builders' News

VOLUME XVIII. SAN FRANCISCO, CAL., MARCH 9, 1907 No. 10

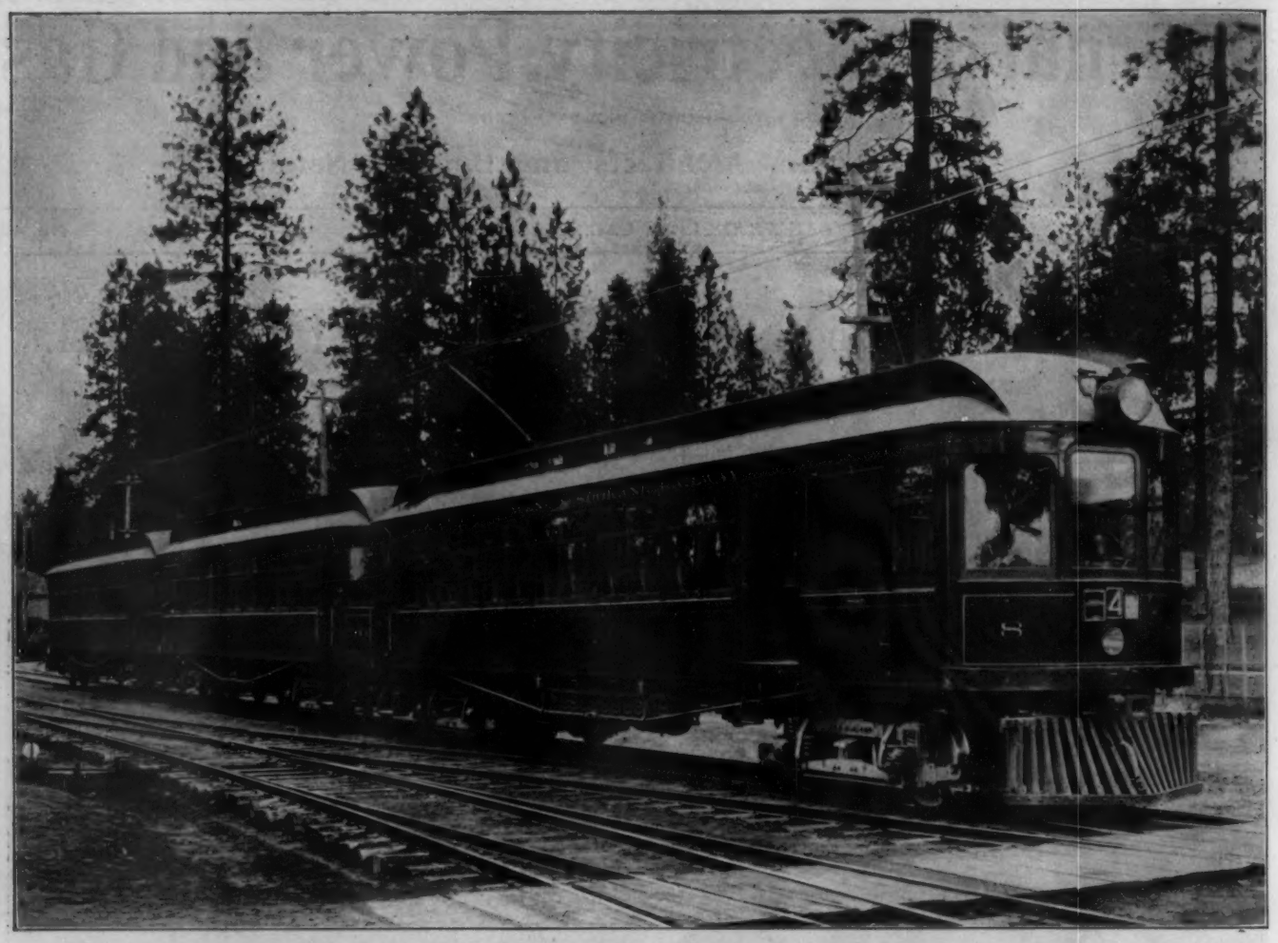
Electricity Replacing Steam on Railways of Pacific Coast.

The electrification of steam railways is not confined to the eastern states, or to the countries of Europe. On the Pacific Coast electric power is being utilized, not only for street railway systems, but also railway lines which formerly were operated by steam, and others under construction which under normal conditions of the past decade, would be equipped with steam locomotives, now are provided with electric freight engines, and the trains for passenger service are electrically equipped.

The accompanying illustrations show the line, stations and passenger, as well as freight trains and locomotives of one of the most interesting railway systems in the western states, the Inland Empire Electric Railway system of the State of Washington. The illustrations also indicate the construction and arrangement of the electrical apparatus of the sub-stations and the frequency changing stations employed for supplying current to this electrified system.

Spokane Electric Terminal at Main Avenue and Lincoln Street. The building is 30x160, and is used as a terminal by the Coeur d'Alene & Spokane Electric Railway and the Spokane & Inland Electric Railway. The executive offices of the Inland Empire System are located in this building, and the several offices of the Coeur d'Alene & Spokane Electric Road, Spokane & Inland and the Spokane Traction Co., all subsidiary companies of the Inland Empire System. The building cost $110,000, and is finished in golden oak with native marble trimmings.

The Spokane and Inland Empire Railroad Co. was organized in the State of Washington, to construct and operate electric properties, owning two valuable power sites on the Spokane River, and also a franchise for the distribution of electricity.



The "Shoshone Flyer," which leaves Spokane Electric Terminal every morning in the year at 8 o'clock over the Coeur d'Alene & Spokane Electric Railway for Coeur d'Alene City, Idaho, where the Red Collar steamer is taken for Harrison, at which point connection is made with the O., R. & N. for Wallace, Wardner and points in the Coeur d'Alene mining country. This train makes the run to Coeur d'Alene—a distance of thirty-four miles—in one hour.

It has also acquired the Spokane Traction Co., which is an electric street railway system operating in the City of Spokane. The Spokane Terminal Co. is included in the same system, owning freight yards, passenger and freight terminals, as well as rights of way in Spokane.

The Inland Empire System also has acquired the holdings of the Coeur d'Alene and Spokane Railway Co., Ltd.,

Freight terminal used by the Inland Empire System. The building is 40x300 feet. The present freight terminal grounds are 300x2,000, and are located directly between the Great Northern yards on the north and the Northern Pacific yards on the south, and connected with both by transfer track.

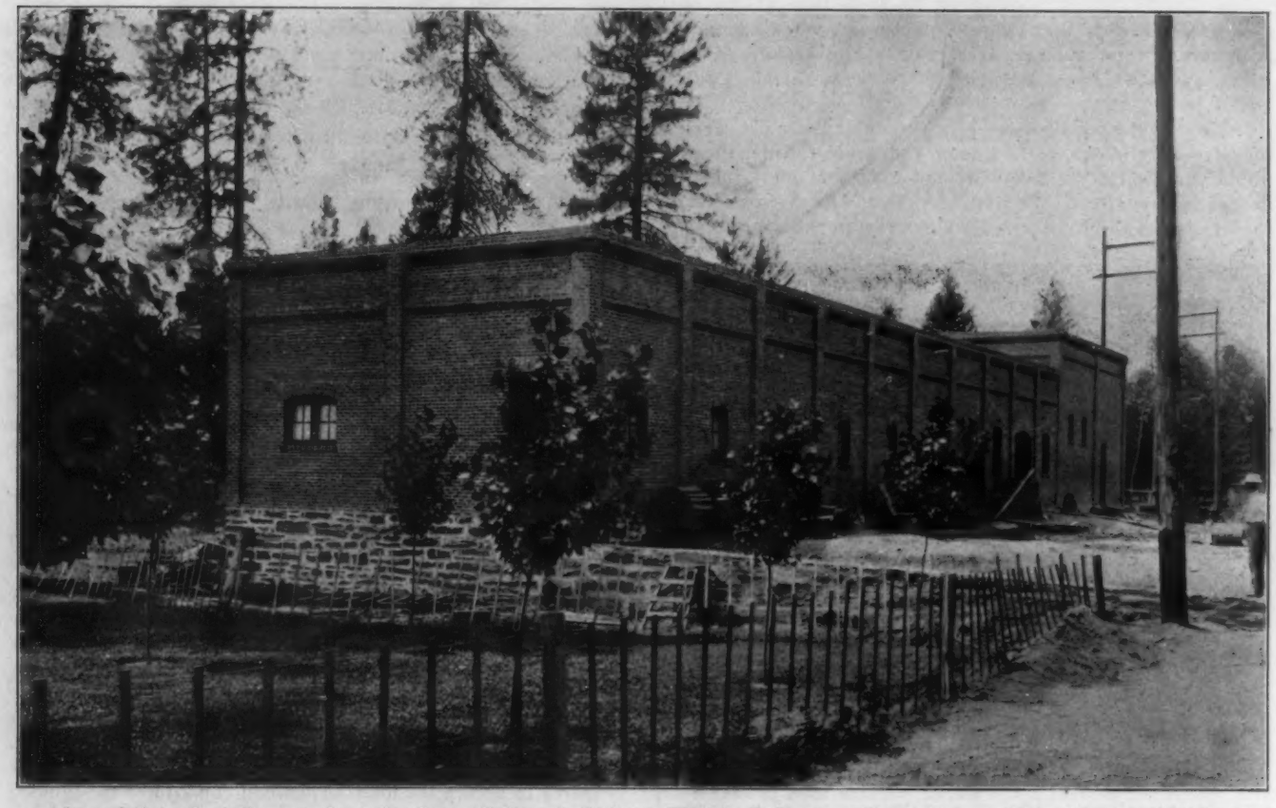
and electric railway operating between Spokane, Washington, and Coeur d'Alene and Hayden Lake, Idaho, as well as the Spokane & Inland Railway Co., building an electric railway between Spokane and Colfax, Washington, and the City of Moscow, Idaho.

An electric power development of from 20,000 horsepower to 30,000 horsepower is owned by this Inland Empire System, the two power sites being on the Spokane River, one at Nine Mile Bridge now being developed and the other the "Bowl and Pitcher," at the city limits.

The Nine Mile Bridge power plant has a capacity of 12,000 horsepower, and it is stated that the location is ideal on account of the canyon's narrowness and rocky formation at this point. There is a lake made by the dam which is useful for regulating the flow of water, this lake being about five miles in length.

Until this power development is completed electric power is being obtained from local power circuits under a ten years' contract, this electric power to be used as auxiliary to the main power stations, when they are in complete operation. The price paid for electric power is $20 per horsepower per year for 24-hour service.

The frequency changing station shown in the accompanying illustrations supplies current to the Spokane & Inland Railway and the other lines, and is located at Spokane, on the former line. The booster sets in this sub-station are used in connection with the storage battery plant and the direct-current machines. These motor generators, the motor-driven exciter sets and main motor generator sets, together with the switchboard equipment, was designed, constructed and installed by the General Electric Company, of Schenec-



One of the sub-stations used on the Coeur d'Alene & Spokane Electric Railway. This station contains 400 and 200 kilowatt rotary converters; also storage batteries to control peak loads and operate line in case of trouble with alternating current system.

tady, and the Westinghouse Electric & Mfg. Co., of Pittsburg, Pa.

There are four main motor-generator sets in this station with three machines mounted on the same base. These sets include a direct-current shunt-wound generator utilized in connection with the storage battery to take off peak loads, the same as in standard direct-current practice.

The 60,000-volt, high-tension oil switches are located in the gallery, the main switchboard being used in operating the four 1,000-kilowatt motor-generator sets seen in the frequency changing station.

Electric locomotives used for freight hauling on the Spokane & Inland division of the Inland Empire System. For long and heavy hauling these locomotives are used in pairs. Each unit has 600 horsepower and weighs 50 tons. With direct current, on the Coeur d'Alene & Spokane Electric Railway, one of these units hauls 1,080 tons with ease up a 1 per cent. grade. On the Spokane & Inland division, with alternating current, one unit will handle 315 tons on a 2 per cent. grade. The Inland Empire System has six of these locomotives for use on the Spokane & Inland Railway.

There are panels also on the main switchboard with apparatus for handling the storage battery current in connection with the direct-current machines to control the peak loads.

In the rotary transformer sub-stations used on the Coeur d'Alene & Spokane Electric Railway there are also storage battery plants for regulation purposes and also for controlling the peak loads, and employed also in emergencies in case of accident or trouble on the alternating-current system. In these sub-stations the rotary converters employed are of 200 kilowatts and 400 kilowatts capacity, the usual electric railway practice being employed in connection with these installations.

The current is conducted along the lines by overhead feeders and tapped in to the overhead trolley wires in the usual manner, in the case of the passenger trains ordinary trolley poles being used for taking the current from the trolley conductors, and with the freight locomotives special collecting devices being employed in addition to the usual trolley pole, which is also provided on these electric locomotives.

The electric locomotives used for freight hauling on the Inland Empire system are shown in the accompanying illustration, two being used in pairs for long and heavy trains. Each of these electric freight locomotives weighs 50 tons and develops 600 horsepower. It is maintained that on the Coeur d'Alene & Spokane Electric Railway, one of these units hauls 1,080 tons with ease up a one per cent grade, utilizing direct current. On the Spokane & Inland division, with alternating current, it is stated that one unit will handle 315 tons on a two per cent grade. There are six of these high-power electric locomotives for use on the Spokane & Inland Railway.

This portion of the Inland Empire System extends in a southerly direction from Spokane to Spring Valley Junction, where the road branches, the western division extending into Rosalia and Colfax, and the eastern division to

Oakesdale, Garfield and Palouse. The road, when completed, will have a total mileage of 113 miles, the eastern division being extended from Palouse to Moscow, Latah County, Idaho.

The freight terminal used by the Inland Empire System includes a building 300 feet long and 40 feet wide, the terminal yard being 300 feet wide and 2,000 feet long and connected by transfer tracks with the Great Northern yards on the north and the Northern Pacific yards on the south.

General view of frequency changing station used by the Spokane & Inland Railway in Spokane, showing motor generator sets with direct current shunt wound machine used in connection with storage battery to take off peak loads, same as in standard direct current practice; also showing 60,000 volt high tension oil switches in gallery to the left.

The accompanying illustration shows the "Shoshone Flyer," carrying passengers to Coeur d'Alene, a distance of 34 miles, in less than one hour, every morning. The Red Collar steamer leaves from this point for Harrison, where many make connection for the Coeur d'Alene mining country. The Spokane Electric Terminal is located at Lincoln Street and Main Avenue, and is used by all of the lines of the Inland system. The building cost between $100,000 and $200,000, and is 160 feet long and 60 feet wide, finished in golden oak with native marble trimmings.

Spokane has a population of 85,000 with real estate worth $15,000,000 transferred in one year and $13,000,000 expended in buildings in the last six years. There are great opportunities for these electric lines, it is claimed. On Coeur d'Alene the annual cut of timber is 30,000,000 feet and 100,000,000 feet on the St. Joe and St. Maries Rivers.

FACTS PERTAINING TO AIR COMPRESSORS.

If air at atmospheric pressure and 60 degrees F. could be compressed to 100 pounds gauge-pressure, and all the heat due to the work of compression taken away as fast as generated, so that the temperature during compression would remain constant, the mean effective pressure during one stroke of the air piston would be 30.2 pounds. If, on the other extreme, none of the heat due to the work of compression is taken away, the mean effective pressure during the stroke will be 41.6 pounds, and the terminal temperature will reach 485 degrees F. As the power required for compression is directly proportional to the mean effective pressure, it will be seen that the additional power required in the latter case is 37½ per cent of that in the former. In practice neither extreme can be reached, for it is impossible to completely cool the air during compression, and, on the other hand, some of the heat of compression will be radiated; but the lower extreme is the ideal, and the nearer it can be approached the more economical will be the work done.

TRACTION ECONOMICS.

Lecture Delivered by Mr. Elbert G. Allen to Students in Electrical Engineering, University of Washington, January 16, 1907.

The commercial problem is always one of dollars and cents. An electric railway has its quasi public functions wherein it should make every effort to warrant the confidence of the public intrusted to it in the granting of its franchise. Nevertheless, the fact must always be borne in mind by the engineer that in order that the public may reap the full benefit to be obtained in the way of cheap transportation the economics of the corporation are a matter of public concern. Moreover, while the corporation is a servant of the people the engineer is a servant of the corporation which has made the existence of the public utilities possible. It is consequently a matter of interest to the engineer to know something of the manner in which money is raised and handled for the construction and operation of the plant.

An electric railway may be owned by an individual or by a number of people, generally the latter. In such a case a stock company is usually organized and certificates of stock issued as evidence of the proportionate ownership of the holder. It is these stockholders who have taken the initiative and the risk to whom the legitimate profits of the business belong. The amount of money to be raised is generally so large that it is advisable to borrow a part, mortgaging the property to secure the loan. This loan constitutes the bonded indebtedness of the company. As a company is never bonded to a greater extent than is fully covered by the actual value of the property, the risk assumed by the bond holders is small, and the interest correspondingly reasonable. Practically all risk of failure of the proposition or loss through depreciation or other causes is assumed by the stockholders, and it should be the aim of the management to return to the stockholders as large a dividend as is reasonable in return for their risks.

The expenditures of a company are broadly divided into two classes: First, those which add to the value of the plant, and, second, those which are for the operation of the plant or for maintaining it in first class shape. Expenditures for increasing the value of the plant are rightfully paid for from any funds resulting from the sale of stock or bonds. Any new line, a new side track or feeder, is just as much a part of the capital expenditure as is the originally constructed road. It is expected, however, that the plant will maintain itself in as good condition as new and the replacing of worn-out apparatus and the current repairs add nothing to the value of the property, and, consequently, must be paid for out of the earnings of the road.

Next to the payment of actual operating expenses and maintenance charges the fixed charges must be taken care of. These consist of such things as interest on the bonded indebtedness. Failure to meet such obligations results in the foreclosure of the mortgage and the passing of the property into a receiver's hands. For any company to remain self-sustaining, its revenue must be sufficient to pay its current expenses, maintaining its plant in good condition, and also its fixed charges. From the surplus remaining after paying these things, the directors may at their discretion reserve funds to take care of the depreciation, which must take place in all machinery in spite of the best of care, for replacing obsolete apparatus and any other so-called sinking funds. Any funds remaining may be paid to the stockholders from time to time as dividends.

The question of proper sinking funds is one which is peculiar to the situation. In all plants there are certain kinds of depreciation which cannot be avoided. For example, in the present state of the art of electrical apparatus rapidly

becomes obsolete, and if a plant is to maintain itself as an up-to-date system, it must from time to time replace such apparatus with more modern types. Sinking funds are often reserved for this purpose.

Calculations to determine the most economical kind of construction, amount of material, etc., almost always involve both factors of expense—operating expenses and fixed charges. The kind of construction which costs most to install, and hence adds most to the fixed charge account, is usually the cheapest to operate and vice versa.

To take a very simple case, let us calculate the most economical amount of feeder costing $1.00 per million c. m. feet, erected for a 10,000-foot car line using 1,000 amperes with power worth $30 per kilowatt year, allowing 10 per cent fixed charge on the feeder. Figuring on a theoretically uniformly tapering conductor and a uniformly distributed load, we find that letting X equal the number of million c. m. feet of copper used,

$$\text{Voltage drop} = \frac{10.5\ A\ L}{cm} \qquad cm = 1/2\ cm \times L$$

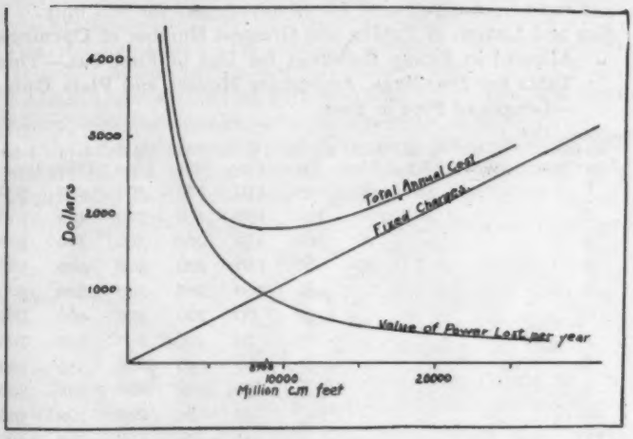
Where A = total amperes
L = length in feet
cm = area at station end.
Z = total cm feet.

$$\text{Watt loss} = 1/2\ AV - \frac{10.5\ A^2\ L^2}{4\ Z}$$

Substituting values,

$$\text{Value of power lost} = \frac{7{,}875{,}000}{X} \text{ dollars per year}$$

$$\text{Fixed charges,} = 0.1X \text{ dollars per year.}$$

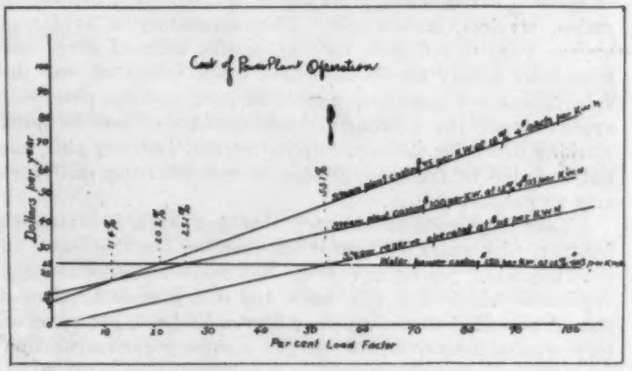


These curves are shown graphically, and their sum, representing the total annual cost, shows a minimum at about 8,900 million c. m. feet. From this we see that for the conditions assumed the most economical feeder would start with 1,780,000 c. m. at the station.

In comparing the costs of operating different types of plants a diagram similar to figure 2 is frequently convenient. In this diagram the costs of operation are shown as functions of the load factor on the station. The costs are separated into the fixed charges which are a certain percentage of the investment, and the operating costs which are nearly proportional to the output with steam plants and vary approximately with the size of plant for water powers. Thus, with the figures assumed it is seen that for loads which occur but 11.4 per cent of the year or less, the cheapest operation is from a steam plant cheaply installed in spite of its larger operating cost. For loads with load factors of from 11.4 per cent to 25.1 per cent the more elaborate but economical steam plant is the cheapest, while for the base load the water power has the advantage. If, however, a reserve steam plant is maintained, it would be cheaper to operate it on all loads with a load factor of 53.1 per cent or less, rather than install additional water powers.

Fig. 2.

Cost of Power Plant Operation.

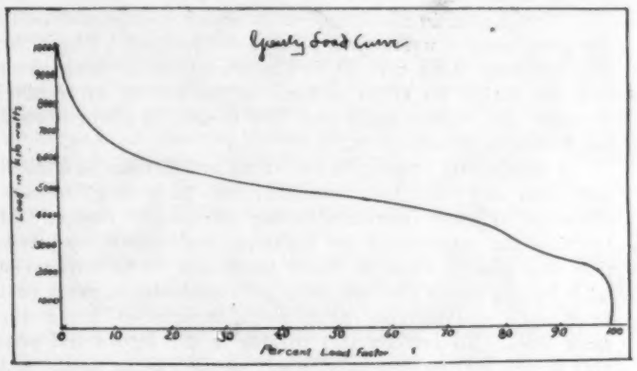


Per Cent Load Factor.

In using this chart, another similar to Fig. 3 is convenient. This gives the load factor of any given load. For example, in the instance given a load of 5,000 kilowatts was carried 40 per cent of the time during the year. Comparing the two charts it is seen that about 5,500 kilowatts could be economically carried on water power, 1,000 kilowatts on a high-grade steam plant and the remaining 3,500 kilowatts on a cheap steam plant.

Fig. 3.

Yearly Load Curve.



BIG FIND OF ANTHRACITE.

The United States Consul at Riga reports that large deposits of anthracite coal have been discovered in the Russian territory of the Orenburg Cossacks. The depth is only 56 inches, and the vein extends about 133 miles north to south, and at about the same distance in a southerly direction from the Great Siberian Railway. The great value of this discovery, it is stated, lies in the proximity of the coal fields to the Ural iron and steel industry, which is at present mainly dependent upon wood and charcoal for fuel, and therefore otherwise incapable of a further expansion. In view of the probable early exhaustion of the South Russian iron-ore mines, estimated to take place in abouty twenty to thirty years, the Ural district is destined to become the largest producer of iron and steel in the Russian Empire. In the neighborhood of the coal fields, deposits of brown hematite have been found.

REHABILITATION OF CUSTOMERS' PIPING.*

No doubt you have all noticed from time to time that gas properties are being purchased throughout the country, and that in almost every case the new owners are called on to spend a vast amount of money in rehabilitating the works, mains, services, meters, etc. This apparently is as far as anyone goes to put their own properties in good shape and earn more money for them. I have often wondered why the subject was not gone into a little further, and the pipes and appliances of the customer rehabilitated and put in good working order for the consumption of gas, and why this was not included in the general plan of rehabilitating the property so purchased.

Take any good-sized town that has been in existence for, say, fifty years. There is no question but that some of the customers' piping is entirely too small to serve the gas appliances which they now have, and if any more appliances should be added to their piping they would not get satisfactory results, neither would the gas company get satisfactory revenue.

And, again, for years past gas companies have been running pipes for appliances, but I have never heard of a case where a gas company made a first installation that they ever ran any pipe larger than required by the appliances installed.

It has been common practice to go into a man's premises who is just commencing to use gas, and if his first purchase is that of a range, if the distance is not too great, to run ¾-inch pipe from the meter to the range. Then if a water heater were subsequently purchased the heater would be connected to this first piping; and if a laundry stove or other appliances were purchased, they would also attach them to this piping. In this way the original pipe which was installed is made to become the fuel system, and, of course, becomes too small to serve the purpose for which it was installed.

Then, again, in the fitting work which has been done in the past, quite a number of pipes were trapped. These the gas company takes care of in the winter by blowing them out, but makes no effort to remove the source of trouble. Summer time comes again and they forget all about it until the following winter.

A systematic inspection of piping and fittings in almost any town will show that somebody will have to go to considerable expense in rehabilitating customers' piping. At the time the majority of the buildings were piped, no attention was paid to sizes, to allow appliances to be introduced later for the use of gas, and even gas companies in years past have done considerable poor work themselves along the same lines. To remedy this trouble in the future and provide means for the customer to get all the gas he wants, and at the time he wants it, a set of rules and regulations for running piping for fuel is herewith submitted.

All new buildings should be equipped in accordance with same, and all pipe work run by the gas company should also be run according to these rules. These rules are based on the class of buildings the pipes are to be placed in. A residence that has a laundry, kitchen and three or four fireplaces should be figured about as follows: Each laundry to be counted as one opening; each kitchen to be counted as three openings; each fireplace to be counted as one opening.

At the time the building is built, pipe should be run to supply fuel appliances at each of these locations. If appliances are not to be installed at the time building is piped the fitter should be permitted to run the pipes to these locations and cap up. If in an old building the gas company receives an order to place a gas range, the necessary fuel pipe of the proper size should be run in the basement to supply all the appliances that may be used in the building at any time.

*A paper read by Mr. John C. D. Clark, of St. Louis, Mo., before the National Commercial Gas Association.

In making the run through the basement, plug openings should be left in the fuel line opposite such fireplaces and other locations where fuel appliances are to be used. While, of course, in the start, this will cost the gas companies a trifle more for pipe, and a slight increase in labor, it will always leave them a fuel system in each of their customers' houses that will take care of any additional appliances that may be installed later.

In cases where Ruud or Monarch water heaters, or appliances of similar character, are to be installed, a separate exposed run should be run direct from the meter to the location of the appliance. When exposed piping is run it would be well to hang pipe so there is a ¾-inch clear space between pipe and ceiling to admit tools for the purpose of cutting run to insert tees.

In conclusion, would say that the matter of piping for appliances comes so close to the commercial man that it behooves him to be on the alert and see that the proper sized piping is run to all appliances, so that all our customers may obtain satisfactory service from the appliance installed, and that we do not have to be continually tearing up their premises to run larger sized pipes. Put just a little more money into good, first-class appliances and good-sized piping and you will not be under continual expense for maintenance or rehabilitation work. Everybody hates to pay out money for repairs, and when you are placing an appliance for anyone is the time to get the money required to have it installed properly, and do not place yourself in the position where you will have to go to anyone and ask him to spend money for repairs or maintenance.

Fuel System.—All piping for a separate fuel system must be taken from the service pipe, a separate meter provided, and must be run and used for supplying gas for fuel only.

Size and Length of Tubing and Greatest Number of Openings Allowed in Piping Buildings for Use of Fuel Gas.—This Table for Dwellings, Apartment Houses and Flats Only.—Length of Pipe in Feet.

Number of ¼-inch. Openings.	½-in. Pipe.	¾-in. Pipe.	1-in. Pipe.	1¼-in. Pipe.	1½-in. Pipe.	2-in. Pipe.	2½-in. Pipe.	3-in. Pipe.	4-in. Pipe.
1	15	50	80	100	150	200	300	400	500
2	..	30	60	100	150	200	300	400	500
3	..	..	40	100	150	200	300	400	500
4	..	..	20	80	120	200	300	400	500
5	..	..	..	50	100	200	300	400	500
6	..	..	..	30	80	200	300	400	500
7	..	..	..	25	70	200	250	350	500
8	..	..	..	20	60	150	250	350	500
9	..	..	..	...	50	120	220	300	500
10	..	..	..	...	40	80	200	300	500
11	..	..	..	...	35	70	180	250	400
12	..	..	..	...	30	60	150	220	400
13	..	..	..	...	25	50	120	200	350
15	..	..	..	...	20	40	100	150	300
20	..	..	..	...	...	30	70	120	250
25	..	..	..	...	...	25	50	90	200
30	..	..	..	...	...	20	40	60	170
35	..	..	..	...	...	...	30	40	150
40	..	..	..	...	...	...	20	30	120
45	..	..	..	...	...	...	...	25	100
50	..	..	..	...	...	...	...	20	80
65	..	..	..	...	...	...	...	...	60
75	..	..	..	...	...	...	...	...	40
100	..	..	..	...	...	...	...	...	20

No illuminating flames will be allowed, and no branches or outlets provided for other openings than those intended for fuel appliances, such as fireplaces, kitchens and laundries. Illuminating burners will positively not be allowed on fuel systems under any circumstances.

Rules Governing Size of Pipe.—To govern the size of piping to be used for fuel systems, the following rules should be followed:

Consider that each apparatus will be used to its maximum, and all pieces at one and the same time. Use as a

basis for figuring pipe the following in ordinary residences and flats: Kitchen, 3 openings; laundry, 1 opening; each fireplace, 1 opening. An opening is figured to be ½ inch. For large buildings, consult the company for sizes of piping required. No fuel opening should be less than ½ inch. In figuring up the number of openings to be supplied, use the following relations:

One ¾-inch opening = two ½-inch opening; one 1-inch opening = four ½-inch openings, or two ¾-inch openings; one 1¼-inch opening = seven ½-inch openings, or four ¾-inch openings, or two 1-inch openings; one 1½-inch opening = twelve ½-inch openings, or six ¾-inch openings, or three 1-inch openings; one 2-inch opening = twenty ½-inch openings, or ten ¾-inch openings, or five 1-inch openings, or three 1¼-inch openings, or two 1½-inch openings.

If exact number of openings required is not given in the table, use the next larger size of pipe. Openings ½ inch in diameter will be allowed only when the maximum amount of gas to be used through them does not exceed 50 cubic feet per hour for each opening.

Length of Pipe.			Inches.
Do not run over	15 feet of	.....	½
" "	50 "	.....	¾
" "	80 "	1	
" "	100 "	.....1¼	
" "	150 "	.....1½	
" "	200 "	2	
" "	300 "	.....2½	
" "	400 "	3	
" "	500 "	4	

Residence or flat of 12 rooms or under: Kitchen openings, not less than 1 inch; laundry openings, not less than ½ inch; fireplace openings, not less than ½ inch.

Residence or flats of 13 rooms and over: Not less than 1 inch; not less than ¾ inch; not less than ½ inch.

All Ruud, Monarch and Columbia water heaters and heaters of this type should be provided with separate runs, as provided in the following table:

Columbia.	Monarch.	Ruud.	No. of Openings.
No. 0	No. 0	No. 3	7
No. 1	No. 1	No. 4	7
.....	No. 2	No. 6	12
.....	No. 3	No. 8	20

Hotels, boarding houses, restaurants, etc., should be considered special. The table is sufficient to cover almost any case of fuel piping sizes that may arise, but it is advisable for architects, builders, and others installing fuel piping systems to confer with the company's inspectors on all such installations in large buildings. Openings for fuel appliances should, as a rule, be 12 inches from the floor and project 1½ inches clear from the finished wall. All other rules for piping and inspecting not inconsistent with these, will be the same as for the illuminating system.

For Gas Engines.

Size of Engine.	No. of Openings.
1-horsepower	4
2-horsepower	7
5-horsepower	12
7-horsepower	12
12-horsepower	20

Supply for gas engines must be separate, and an independent service will be required, unless a governing holder or other similar device, acceptable to the company, is used. It is advised that before proceeding with the installation of gas engines, or piping for same, consultation be had with gas company's inspector.

A CONTINUATION OF THE REPORT OF COMMITTEE ON ELECTROLYSIS, PREPARED FOR THE AMERICAN GAS LIGHT ASSOCIATION.

Detroit, Mich.—The results of an electrolytic survey of the water and gas pipes of Detroit, made by Mr. A. A. Knudson, in 1905, are given in a report addressed jointly to the Board of Water Commissioners and the Detroit City Gas Company. The following abstract of this report is given with the permission of the above parties:

The present situation in Detroit, as a result of previous attempts to avoid damage by electrolytic action, is briefly as follows:

In 1896 the first examination authorized by the Board of Water Works appears to have been made under the supervision of the then General Superintendent, Mr. L. N. Case.

At that time there were three electric railway companies operating in the city, the Citizens, the Detroit and the Fort Wayne and Belle Isle Railway Companies. The latter was not considered a source of danger, its system being comparatively small.

The plan for protection which was pursued is outlined in the following extract from Mr. Case's report: "The necessity, first, is to keep the electricity off the pipes as much as possible in those districts where there is a tendency to overflow from the rails. This can be accomplished by providing a more liberal system of return conductors. The uninterrupted conductivity of the rails should be first insured, an additional feeder of copper wire being sometimes used independent of the rails. The next step is to arrange special return wires from the pipes to the rails or to the return cables in what are known as the danger districts, which are almost entirely within a short radius of the power houses."

The quotations are made for the purpose of establishing the origin of the bonding system found generally in vogue in Detroit upon the water mains.

The bonding of gas mains to the railway returns was probably begun in June, 1903. It was found necessary to place bonds around the lead joints of the 12-inch wrought iron main in Riopelle street, to prevent their melting out, owing to the heavy currents flowing through them, which were caused by its connections with the railway returns. A few other bonds have been placed upon gas mains at other points in the city.

We will now consider the situation as found at the present time. Since the first bonds were placed upon the water mains the railway companies have combined and are now operating under one management, called the Detroit United Railway Company. This company has freely co-operated with the Water Department in efforts to avoid electrolysis. They have installed bonds and connections to pipes with their returns at their own expense, first obtaining the consent of the parties owning the same, and are keeping watch through annual voltmeter surveys of danger districts in all parts of the city.

Over 150 measurements were made upon the water mains, and nearly as many upon the gas mains. The danger points in Atwater street refer to gas entirely. One service pipe was found leaking where it was exposed by the excavation for the new 10-inch water main, which leak was due to electrolysis.

This (+) condition of gas pipes is, without doubt, caused by both the fire main and the water main in the street being bonded to the railway return. The recent bonding of the fire mains has brought about this result in several places in the city, one marked instance being at Cass avenue and Lafayette street, where both water and gas mains are positive to those mains, and another at Miami avenue and Witherall street; at the latter place the two water mains and the fire main have been bonded to-

gether. The 4-inch gas main found at this opening was considerably damaged by electrolysis.

Jefferson Avenue—Several gas service pipes have been destroyed through this part of the street, and about 30 feet of 4-inch cast iron main replaced with new pipe, all owing to electrolysis. Between October 17th and 31st, the 4-inch cast iron gas main was bonded to the 12-inch wrought iron gas main by the railway company with a view to stopping further damage.

It should be understood that as the 12-inch wrought iron gas main is connected to several railway negatives, both underground and overhead, which lead direct to the power house, bonding the 4-inch gas main to it, practically connects the entire system of gas mains in this vicinity to the railway returns. The same may be said of another case of bonding at Fort and Riopelle streets, where the 4-inch gas main was bonded to the 8-inch water main, the water main being already connected to an overhead negative.

At Fisher avenue we find a maximum flow of 341 amperes. This is further added to as shown at Field avenue, making 373 amperes, the flow being west at both tests. At Bellevue avenue (same time of day as at Field avenue) it is 148 amperes.

At Meldrum avenue the 42-inch main turns north and thence goes through Congress street. As the pipes and rails on Jefferson avenue are bonded at nearly every street running north and south, a flow south is found, where tests have been made, to the pipes in Jefferson avenue as far as Riopelle street. At this point all pipes, both water and gas, are bonded not only to rails, but to special cables, both underground and overhead, running to the power house at the foot of this street.

There are two large gas mains in Riopelle street crossing Jefferson avenue, one a 12-inch wrought iron main previously spoken of, and the other a 16-inch cast iron main; both are carrying railway current, but the 12-inch main, owing to the screw coupling joints making the best conductor, as against the lead joints in the cast iron main, carries much the greater current.

The drawing (not reproduced here) shows the method of bonding around the several cast iron parts in the 12-inch main containing lead joints. This copper cable was placed in this way so as to prevent the lead joints from melting, as had been the case in one or two instances, due to the heavy current passing through the main since it was connected to the railway negatives.

The other two one-million cir. mils cables connect with other larger cables which lead to the power house.

The Twenty-four Hour Test.—In view of the heavy flow of variable current at times upon this main and the desirability of establishing the readings at any time in 24 hours for future comparison, a series of highest and lowest millivolt (1 millivolt = 0.001 volt) readings was taken every five minutes, beginning at 5 p. m., October 17th, and ending at 5 p. m., October 18th. The current flow in amperes was deduced and plotted, and also the power house log was plotted for the same hours. The relative plots showed very faithfully the variation of current strength on the 12-inch main to be synchronous with that of the power house, making the identification of the source of current on the main complete.

Increase of Railway Current.—As a traction system expands and more cars are added, more current is required to move the same, consequently an increased amount of current will return by the mains.

Another reason for the increase of current strength upon underground mains is the bonding of mains to rails or to negative busbar, also bonding one set of mains to another, such as gas mains to water mains. An idea of such an increase is given in the following comparative tables, in which an average is obtained of three readings selected from the evening load at the power house and three readings from an evening load on the gas main, showing the per cent. of increase in the past two years:

Switchboard Readings D. U. Railway Power House During Evening Rush Hour Years 1903 and 1905

Time	Date	Amps.	Ave.	Inc.
P. M.	1903 May			
5.00	28	11,000		
5.30	"	13,500	13,000	
6.00	"	14,700		
	1905 Oct.			
5.00	17	19,000		
5.30	"	20,000	20,000	53%
6.00	"	21,600		

Current Flow on 12-Inch Wrought Iron Gas Main. Years 1903 and 1905

Time	Date	Amps.	Ave.	Inc.
P. M.	1903 May			
5.00	28	2,290		
5.45	"	3,050	2,848	
6.00	"	3,205		
	1905 Oct.			
5.00	17	3,400		
5.45	"	3,600	3,410	20%
6.00	"	3,250		

Fire Department Mains.—This system of mains is used solely for fire protection and they are generally known and spoken of as "Fireboat Mains," as during fires, water from the Detroit river is pumped through them by a fireboat.

These mains, which are so important to the city, have been seriously affected by electrolysis. We have already referred to one of the effects of current flow through them —the possibility of damage at joints. These mains, as well as the gas and water mains, are connected with the negative return to the power house, the connections, with few exceptions, having been made during the past summer.

Current Action at Joints.—During this survey the question arose, in the event of further bonding being allowed from gas and water mains to fire mains, how much added flow could be delivered to the fire mains without danger of melting some of their lead joints. (The details of the tests made to determine this are omitted, but the conclusions are given.

Conclusions and Suggestions.

Bonding.—"The bonding of water mains to railway return conductors, as a protection from electrolysis, was commenced in Detroit in 1896, and has continued to a more or less extent since then. The traction system was small at that time as compared with the present. It was supposed then, no doubt, that the same method would answer for large, as well as for small systems.

"Where the safety of all underground pipes is considered in the streets of a city, we are of the opinion that it is not wise to depend upon the bonding method as a final cure for electrolysis, especially where a large traction system using a ground return is in operation.

"Where such a system has been in vogue for several years, however, as in Detroit, it is not advisable to make any sudden or radical change without first having a substitute in use known to the equally efficient.

"Referring to other methods of protection, we quote the following extract from A. V. Abbott's work, entitled, 'Electrical Transmission of Energy,' 1904, page 102 (an authority on the subject), which we believe will apply to the situation in Detroit. After referring to damage by electrolysis to underground pipes, lead cables, etc., he says: 'On account of these difficulties the larger roads are now aiding the ground return by re-enforcing it with copper wire return feeders, looking in the near future to a more or less complete metallic cicuit for the railway system.'

"While the complete metallic circuit, such as in practical use in New York, Washington and Cincinnati (conduit system and double overhead trolley) has not come into general use, the tendency, at least among large railway systems, as Abbott indicates, is in that direction, and something of this kind should be adopted in Detroit.

"If the complete metallic circuit is installed there will, of course, be no further danger from electrolysis of under-

ground mains. In the meantime the situation in Detroit will have to be considered and dealt with as found.

"The system of bonding, while it has advantages, has also disadvantages; for instance, where one set of mains, such as water mains, are bonded to the railway return conductors, other mains in the same streets are, on this account, made electro-positive to them; and, unless also bonded, will be injured by electrolysis. This is the experience covering several years in Detroit.

"Another result from bonding: A much greater flow of current is invited upon the mains and electrolysis action at joints is apt to occur, especially when the currents are heavy. On account of these and other objections, we have never favored the method of bonding mains to rails or to negative returns, preferring means to keep currents off mains, rather than recommending means which make them a part of the return circuit to their detriment.

"In Detroit, however, we find at the present time the water mains and fire mains bonded and the gas mains also bonded to some extent. To prevent immediate electrolytic action upon the gas mains that are now in danger, it will be necessary to bond them also, at least as a temporary measure, until the railway company so improves its return system as to relieve the flow of current upon all underground mains in the city.

"Mr. Burdick, superintendent of motive power of the D. U. Ry., has informed us he stands ready to do this, and, therefore, we have reason to expect a substantial improvement in the near future in the reduction of the heavy currents now passing through some of the mains, as well as from one system of pipes to those of another system.

"Joint Melting Test.—This has been explained in detail and is important in determining what was hitherto unknown, viz., how much current a lead joint will stand before melting. It was found that a poorly-made joint, with much less lead than the average, in an 8-inch water main, in service 38 years, tested in the open air, no water inside, required a current of 2,600 amperes for 14 minutes to cause the lead to melt. More perfect joints will stand more current without failure under the same conditions of test. In view, however, of weak or imperfect joints, such as may be in smaller water mains or in a gas main that is near the surface of the street, subject to changes of temperature and the consequent expansion and contraction, causing high resistance, it is not safe to permit any such flow of current through mains of any size containing lead joints.

"Taking all sizes and kinds of underground pipes, length of service, etc., into consideration, it is our judgment that a maximum flow of 900 amperes is the highest that should be permitted upon any underground main, so far as danger of melting the lead joints is concerned.

"Electrolytic Action at Joints.—Many joints have been examined, both gas and water, in the cast-iron mains, interior as well as exterior. The result has been that, while in some cases evidence of electrolytic action has been found, as a whole no serious damage can be reported. The sizes of joints examined were from 4-inch up to 12-inch. As a rule sizes above 12-inch are not as much affected as the smaller ones, owing to greater surface contact of the metals and consequent lower resistance. It is to be observed, however, that the heavier the flow of current through the mains, the more chance there is for electrolytic action at the joints that are more or less imperfect. The flow of nearly 400 amperes on the 42-inch water main in Jefferson Avenue is for this and other reasons deemed liable to be injurious at some joints in this main.

"The rails are well bonded, but the principal cause for diversion of current to this main is that the mass of cast iron in the main offers a conducting path which competes successfully with the rails in carrying capacity.

"Another instance is a joint in a 24-inch main which shows high resistance even after being newly caulked (owing to a leak) at Congress and Randolph Streets. The flow at one test through this main was 203 amperes.

"This joint is still in service, and exterior examination shows electrolytic action on the (+) spigot side close to the lead packing. As a rule, however, we have found very few joints showing high resistance. A reason given by Mr. Hubbell is that much care is given to the packing of all lead joints. This statement is borne out by personal observation.

"The Twenty-four Hour Test.—The curve sheet shows the minimum and maximum strength of current during the 24 hours returning through the 12-inch wrought-iron gas main. This main is connected by heavy copper cables to the power house, which accounts for the heavy flow, at times above 3,000 amperes. The power house load current is also plotted on the same sheet and shows the similarity in variations at the same hours. The railway company has agreed to substantially reduce this flow upon this main by constructing additional track auxiliaries.

"Attention has been called to the increase of current strength of the traction system during the last two years. A short table shows 53 per cent. increase in two years' time at the D. U. Railway station, and 20 per cent. at the gas main above referred to, between the years 1903 and 1905.

"As it is probable that the same ratio of increase may be expected in future, unless a change is made, it is our opinion that a condition is being approached which makes it imperative that the railway company should make such change as soon as possible, at least before another summer's traffic commences."

REINFORCED CONCRETE CONSTRUCTION ON THE PACIFIC COAST.

Already it is quite apparent that reinforced concrete is to enter largely in the reconstruction of San Francisco. There is scarcely a block in the down-town burned district that will not soon boast of at least one reinforced concrete building, for they are to be seen on every hand in various stages of construction. A five-story building on the corner of Geary and Market Streets, is the first structure of this kind to be occupied, while several others of from three to seven stories are in course of erection.

The most notable reinforced concrete building which has yet been announced for San Francisco is to be erected on the corner of Fourth and Market Streets, the site of the old Flood Building. It will be nine stories high and will cost $1,000,000. Its exterior, for the first two stories, will be veneered with ceramic tile in rich browns. Above the second story the entire front will be faced with cream-colored glazed terra cotta in rich detail. The corridors and lobbies will be finished in imported marbles, and six electric high-speed elevators will be installed. One remarkable feature of this concrete structure is the fact that nine stories are made possible within the limit of height to which concrete buildings are restricted by the city ordinance—one hundred and two feet. The first story will have a height of twenty feet; the second, twelve feet; and the other stories, ten feet each. By an ingenious arrangement of the structure, the fact that the roof is of concrete makes it possible to dispense entirely with an attic story.—"Scientific American."

ILLUMINATING ENGINEERING SOCIETY ELECTION OF ADDITIONAL OFFICERS.

Nominees by Board of Nominators:—Vice-Presidents—Chicago Section, Albert Scheible; Pittsburg Section, G. B. Griffin; Philadelphia Section, H. K. Mohr. Directors—J. F. Gilchrist, G. R. Stetson, S. E. Doane.

The following is a list of the present officers and directors of the Society: President, Dr. Clayton H. Sharp. Vice-Presidents—New York Section, A. A. Pope; Boston Section, Dr. Louis Bell; Secretary, V. R. Lansingh; Treasurer, Dr. A. H. Elliott. Directors, E. C. Brown, W. S. Kellogg, E. L. Elliott, W. D'A. Ryan, W. D. Weaver.

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Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," with which is incorporated "The Engineers', Architects' and Builders' News."
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Entered as "The Electrical Journal," July, 1895.
Entry changed to "The Journal of Electricity," September, 1895.

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EDITORIAL.

Direct or Alternating Current for Long Transmission Lines.

In England and on the continent of Europe, there has recently been much written and published in the technical press regarding very long transmission lines, where the conditions would seem to require higher line voltages than have heretofore been successfully used in electric transmission. Many eminent engineers have not hesitated to place themselves on record as favoring the use of direct current instead of the three-phase alternating current for very long, high voltage lines. On the other hand, at least one well-known American electrical engineer has, in effect, discarded with seemingly little consideration, the proposal to use direct current for the transmission of 50,000 horsepower a distance of between 600 and 700 miles, the suggested line voltage being 150,000 volts. His decision is, tersely stated, that there is no question but that the three-phase alternating current should be used. Those familiar with the extensive developments in long distance electric transmission on the Pacific Coast, it must be said, are somewhat inclined to agree with him.

Many points need the most careful consideration in a transmission system 700 miles long at 150,000 volts between conductors, using three-phase alternating current. A sufficient investment in electrical conductors will result in the transmission being satisfactory merely from the standpoint of efficiency or the ratio of the electrical energy delivered to the receiving end and the electrical energy delivered to the line at the generating end. The problem of voltage regulation, however, is an entirely different matter, and may be quite independent of the cost of the line, whether great or little. It may be safely said that in all probability the generating station, step-up transformers, oil-break high tension switches, as well as the sub-stations with their equipment, would not differ materially from those in existing plants, except in the matter of the size of units. The adoption of the three-phase alternating current results practically in concentrating all the important problems and probable difficulties on the transmission line alone.

On the other hand, if direct current were used, the generating and receiving stations, and particularly their equipments, would differ greatly from those now in use, and the multiplicity of machines required for series operation, with their commutators, would probably remind one of the early days of arc-lighting stations, except that the station would certainly be on a gigantic scale as compared with our old constant current arc dynamo equipments.

With direct current, however, the line, even using 150,000 volts between conductors, should not introduce any new troubles other than those which have been successfully overcome at the present time. Except for the tendency of electrolytic action of the direct current, it is probable that the electrostatic strain on the high tension insulators would not greatly exceed that which exists on operating transmission lines where the line voltage is from 60,000 to 80,000 volts, three phase. With direct current, then, by far the largest part of the difficulties of operation would be found in the generating and sub-station electrical apparatus, rather than on the transmission line.

Outside of the necessity of designing and constructing the high tension insulators for such an extremely high line voltage as 150,000 volts, as viewed at the present time, for regular continuous operation, the matter of the so-called charging or capacity current in such a long line is undoubtedly of the most importance, and not only must the charging current be given the most careful attention, but also other phenomena which result from the large capacity and self-induction of the line.

This, however, can be controlled if a sufficiently low frequency is adopted. Certainly 60 cycles, or even 30 cycles, could not be successfully used, and it is also true that on the receiving end it would be necessary to introduce machinery, whether synchronous or induction motors, which would when required operate at a comparatively low power factor, utilizing lagging current to balance the heavy capacity current of the line. It can be shown that the regulation of voltage, with a sufficiently low frequency, is readily accomplished, when the efficiency of transmission is as high as 85 to 90 per cent. It would be absolutely necessary, however, to introduce an artificial inductive

load upon the receiving end of the line, if for any reason the regular operating load should be suddenly disconnected.

From a commercial standpoint, the building of such a long transmission system will depend only upon the cost of power at the receiving end. At 6 per cent. interest on the investment required for the line alone, the cost of transmission per kilowatt per annum for fixed charges would be about $10. To appreciate the magnitude of this charge, it is said that the cost per kilowatt per annum represented by the fixed charges at 6 per cent. of the cost of the line for a 10,000 kilowatt, 60,000 volt, 150-mile line on the Pacific Coast, does not exceed $1.00 per kilowatt per annum.

TRADE CATALOGUES.

Fort Wayne Electric Works' latest publications are as follows:

Instruction Book No. 3,024 gives a complete description of the Fort Wayne system for alternating-current series arc lighting, with careful instructions for the installation of each part from transformers to lightning arresters.

Index to Bulletins Nos. 1,001 to 1,089, covering a list of all bulletins ever issued by the Fort Wayne Electric Works. The Index has been classified in two ways; first, according to subject, and, second, according to number.

Bulletin No. 1,087 describes a standard form of direct-current switchboard panels, and

Bulletin No. 1,089 is devoted to the same thing for single-phase alternating current.

Half-tones and diagrams are complete in both cases.

Bulletin No. 1,090 shows the necessary parts for the installation of a series alternating-current arc lighting system, with data for switchboards, lightning arresters and transformers.

Allis-Chalmers Co.—"Gold Milling in the Black Hills" is the title of Bulletin No. 1420. This is a reprint of a paper prepared by Professor H. O. Hofman, of the Dakota School of Mines, and contains a great deal of matter which will be found of practical value by those who are interested in propositions involving ores similar to any that are mined in the Dakota District.

Allis-Chalmers Co.—Bulletin No. 1,050, entitled "Alternating-current Generators, Water-wheel Type," is a revision of a previous bulletin on the subject. The rapidly-growing number of electric installations renders the subject one of increasing importance, and for that reason will prove of general interest. It is well illustrated.

The Electric Storage Battery Co. has just issued an attractive pamphlet entitled "The 'Exide' Battery Instruction Book." It covers a description of battery parts with general directions for charging and the proper care of the various types of batteries.

If copies are desired or additional information not contained therein is wanted, the above company will furnish it from their main or any of their sales offices.

Power & Mining Machinery Company.—One of the most beautiful specimens of printers' art that we have ever seen is the recent catalogue on "Cement-making Machinery," issued by the Power & Mining Machinery Company, of Milwaukee.

National Brake & Electric Co.—Bulletin No. 373 gives a very clear description of National Motorman's Valves, with half-tones of all the parts. This, together with other bulletins giving full description of each part of National Air Brake Equipments, will be forwarded upon request.

As examples of efficient and up-to-date advertising as practiced by progressive central station companies, we would refer our readers to a neat little illustrated booklet devoted to the possibilities of the electric current for "Heat, Power and Light," issued by the Denver Gas & Electric Co.

Also the Valentine number of "Edison Light," a publication issued by the Edison Electric Illuminating Company, of Boston.

The Benjamin Electric Manufacturing Co. has just issued a beautiful little catalogue of their specialties for the benefit of the Mexican and South American trade. It is printed entirely in Spanish, and we have no doubt but that it will prove of interest and value to our Southern neighbors.

OBITUARY.

The death of George Henry Evans at Berkeley on February 4th has caused wide-spread regret in San Francisco, where he had a large number of friends. Born at Hull, in England, forty-one years ago, he was a mining engineer in active and successful practice. His specialty was placer mining, he being the inventor of the Evans Hydraulic Elevator now used in most hydraulic mining, where the elevation of gravel is necessary. He was a member of the North of England Institute of Mining and Mechanical Engineers, American Institute of Mining Engineers, American Society of Mechanical Engineers, Technical Society Pacific Coast, Franklin Institute, and also a member of the Bohemian Club of San Francisco, where he had a wide circle of friends. He leaves a widow, son and daughter. He came to California ten years ago, to take charge of the operations on the Golden Feather Channel, at Oroville, succeeding Col. Frank McLoughlin as manager. This position he occupied for three years and then he became manager of the Banner Mine, also in Butte County. Subsequently he traveled widely, becoming consulting engineer of various alluvial enterprises in Colorado, California and elsewhere. He was one of the consulting engineers associated with the Risdon Iron Works. As a member of several engineering societies he had a wide acquaintance, among whom a kindly disposition and cultivated manner made him always welcome. The engineering profession has lost a worthy member.

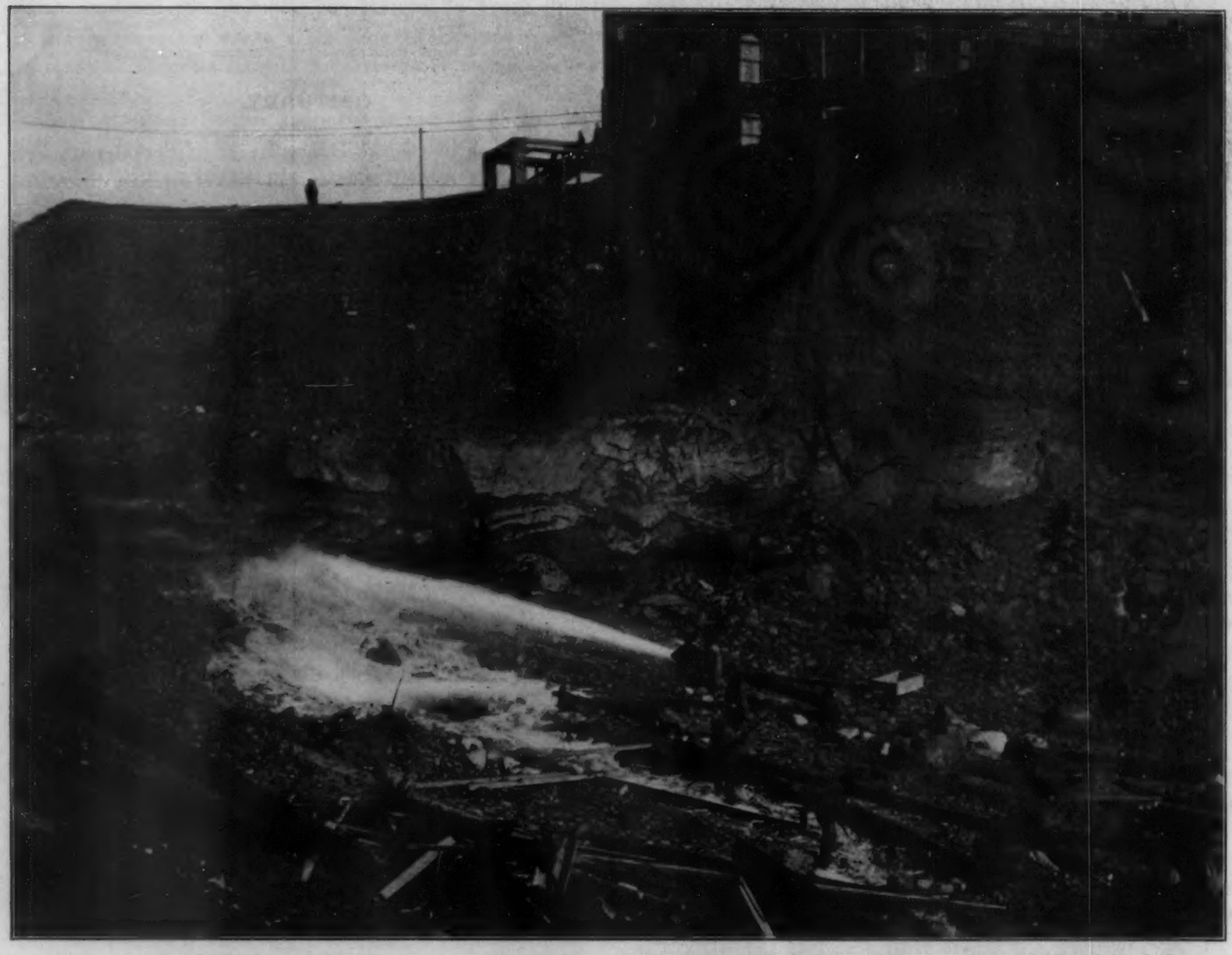
TURBINE BLADES.

The three turbines of the "Carmania" contain in the aggregate a million and a quarter of blades, and those of the "Lusitania" will have approximately three millions of blades together. This means probably over one million of blades for each of the low-pressure turbines The number of blades in the largest turbine which the Westinghouse Company has yet built is something over 85,000, but these turbines being built for electrical station purposes run much faster than the marine turbines, which latter have therefore a much larger number of blades. While the insertion and fastening of all these blades may present a problem to the manufacturer, the entire rotor shaft and attached blades are, so far as the operating engineer is concerned, a single piece. The blades when they leave the builders' hands are really integral with the spindle and case.—Power.

ELECTRO-HYDRAULIC EXCAVATING.

The use of hydraulic methods for removal of earth for various purposes has proven itself the most economical and efficient method where a good supply of water is accessible.

This process has been quite successfully utilized by Mr. H. W. Hawley, of Seattle, in connection with the excavating of the hilly section of that city. He has entered into a contract with several private property owners covering the removal of Denny Hill, one of the prominent landmarks of Seattle, and the site of the Washington Hotel.



SIX-INCH GIANT WORKING ON DENNY HILL, HAWLEY PLANT, SEATTLE, WASH.—WASHINGTON HOTEL, NOW BEING DEMOLISHED, IN BACKGROUND.

Heretofore water has been secured for sluicing from the city water system, which derives its supply from Cedar River, distant approximately thirty miles from the city, but owing to the recent large increase in demand upon the city plant consequent to the rapid growth of the city, the municipal authorities have been compelled to discontinue the disposal of water for purposes other than those usually imposed upon such a system. It was owing to this condition that Mr. Hawley decided to install a sea water pumping plant, taking water from Puget Sound at a point approximately 2,500 feet distant from the point of consumption.

The plant consists of a 600-kilowatt, 2,400-volt, 2-phase, 60-cycle, speed 327 revolutions per minute, Westinghouse synchronous motor, carrying the rotor of a 40-horsepower, 440-volt, 2-phase induction-starting motor mounted on an extension of its shaft—the stator of the starting motor is bolted to a bracket carried on the main bearing pedestal of the large machine. This induction motor has a synchronous speed of 400 revolutions per minute, and is controlled through an auto-starter mounted on a separate panel of the switch-board in the regular manner.

Current for the operation of the plant is secured from the system of The Seattle Electric Company; the 2-phase, 440-circuit for the starting motor being carried direct from transformers placed on a pole outside of the station to the starting motor panel. The 2,400-volt, 2-phase circuit is carried to disconnecting switches placed outside the building and thence to a feeder panel.

The switch-board consists of two panels carrying voltmeters, ammeters, automatic oil circuit breakers, synchroscope and the necessary busbars and small wiring.

The exciter is driven from a pully mounted on the main shaft of the synchronous motor, and is controlled from the operating panel of the switch-board.

Power is transmitted to a 30-inch, 4-stage Worthington turbine pump, through a friction clutch of special design to the main driving pulley which is belted to the pump pulley through the medium of a 48-inch, 4-ply leather belt. The pulley ratio is such as to operate the pump at a speed of 500 revolutions per minute. The belt tension is adjusted by raising or lowering an idler pulley placed about twelve feet from the pump pulley.

The pump has developed a capacity of 4,000 gallons per minute against a gauge head equivalent to 430 feet, and is capable of delivering water at the nozzle of a 6-inch giant

SWITCHBOARD, HAWLEY PLANT, SEATTLE, WASH.

working at the highest elevation required at a pressure of 120 pounds per square inch. The matter to be excavated consists largely of blue clay and is exceedingly tenacious and difficult to move. However, no difficulty has been experienced in the present instance, and the plant has proved to be thoroughly satisfactory in every way.

The hydraulic end of the plant was designed and furnished by Caldwell Bros. Co., of Seattle, working under contract for the owner. The electrical portion of the plant was designed and erected by Kilbourne & Clark Company, of Seattle, under the supervision of Mr. Frederick G. Simpson, chief engineer of that company. All other parts of the installation were installed under the direction of Mr. George H. Tinker, engineer for Caldwell Bros. Co.

MOTOR AND AUXILIARIES, HAWLEY PUMPING PLANT, SEATTLE, WASH.

OUR BERLIN CORRESPONDENT.

Nothing is more interesting at present than the success experimenters here are having with the so-called "Kreissel Pumps," a centrifugal pump, having only three blades, and operated by steam turbines at upwards of twenty thousand revolutions. The friction losses, naturally, are high, but the total efficiency is proving high enough, that the manufacturers of high-speed turbines will doubtless take them up, for direct connection. In addition, it is certain that no other pumping plant of equal capacity could be constructed in as small a space.

Large and small steam turbines seem to be displacing all kinds of engines. Small steam turbines are becoming very popular, and in looking over the advertising pages of the engineering papers, one cannot help but note that the engines are disappearing from the advertisements as well.

From the splendid perspective of this distance, we note by the papers that you are growing, this year, an unusually large crop of second editions of Edisons and Bells. They shout forth the wonders of their new systems of railroading, telegraphy, or motors; promise to make every one rich who will buy a little of their stock. It is not always pleasant to have to explain to our scientific friends here the exact status of such muchly-advertised genius (?) in our country. This year I note wonderful promises regarding a so-called "Cold Motor," a new magnetic railroad, a Chicago-New York electric line, a new kind of magnetic phonograph exploited more on Wall Street than in the retail market, another convulsion of the Wireless Telegraph Trust, to say nothing of the present phase of wild-cat mining, which we had hoped had been burned out of San Francisco. How do you think we explain these things to our steady, conservative German engineers, who cannot comprehend anything that is not all that it is supposed to be, for the simple reason that nothing can exist here that will not bear thorough inspection; for the further reason that it actually will be inspected, and there is no dodging it?

Yesterday evening the local General Electric Co. gave a banquet and exhibition, in which a number of their turbines were exhibited. The Kaiser attended, and mingled freely with the guests, and talked freely with Prof. Slaby, who was present, and others. The lecture of the evening was given by one of the engineers, who showed how the company had developed a very successful turbine from the combination of the Riedler and the Curtiss turbines. The Emperor was very much interested, and inspected all of the exhibits with that lively interest which he shows in everything that is progressive and instructive. Incidentally, most of these engineers are invited to lecture before the Emperor from time to time, which is considered a very great honor, indeed.

It might be not out of place here to note that the German chemists, headed by the great Fischer, are the most advanced in the world. Their works on theory are accepted standards the world over. Fischer is said to have built up a true albument out of non-organic materials. The works of these gentlemen on the chemistry of agriculture and regeneration of worn-out soil are voluminous, and used the world over; yet Germany as a whole needs this regeneration more than any other country of the globe, and nothing is being done, although she is said to control nitrate beds, and other ingredients in different parts of the world, necessary to the purpose. This is a characteristic of German science, to study, rather than to use it.

Professors Stumpf and Riedler are said to be experimenting on gas turbines at their private laboratories, but it is difficult to obtain any information. It is said that they are meeting with great success, with the exception that reciprocating compressors have to be used, hence little is gained by using a gas turbine, since the reciprocating parts are not eliminated, and additional complications added.

Yours truly, E. N. PERCY.

INDUSTRIAL

GOLD DREDGING IN THE OROVILLE DISTRICT.

The writer is often asked by editors of progressive technical publications for a few lines on Gold Dredging, one and all stating that this simple, but little known, method of mining is now attracting more than usual attention, due, no doubt, to the fact of the large, steady dividends this method of mining is returning, and the writer predicts that it will not be very long before gold dredging will not be considered a mining proposition, but will be placed on the same footing as that of a first-class manufacturing industry, and one in which the market for the production is impossible to flood; also, last but not least, the price of the production never fluctuates.

It is not the intention of the writer to go into the early history of successful gold dredging, which, as most people know, has its home in the little, far-distant New Zealand, but rather to take up and describe one of the latest dredges operating in this State, and to the average man, whether he is in the engineering business or not, a trip to Oroville will more than repay him for his trouble and expense.

In Oroville one can see some forty dredges working within a radius of eight miles. These dredges are not, as most people suppose, working in the river, but some are on high land, two and three hundred feet above the level of the river. Of course, they are working in ponds, which receive the water from the river, taken out some miles up river, used for irrigating purposes. Now the irrigating ditches deliver the water into a small pond, in which floats the gold dredge (or a machine for extracting gold out of auriferous gravel), digging up the material in front and taking out all the fines deposited in the gravel when the earth was young, and stacking the waste material at the back of the dredge.

On an average this machine will handle approximately 50,000 yards per month, and the total working expenses are in the neighborhood of twenty-five hundred dollars per month. Therefore, if the ground is worth sixteen cents per cubic yard, one can readily see what enormous dividends this gold manufacturing machine pays.

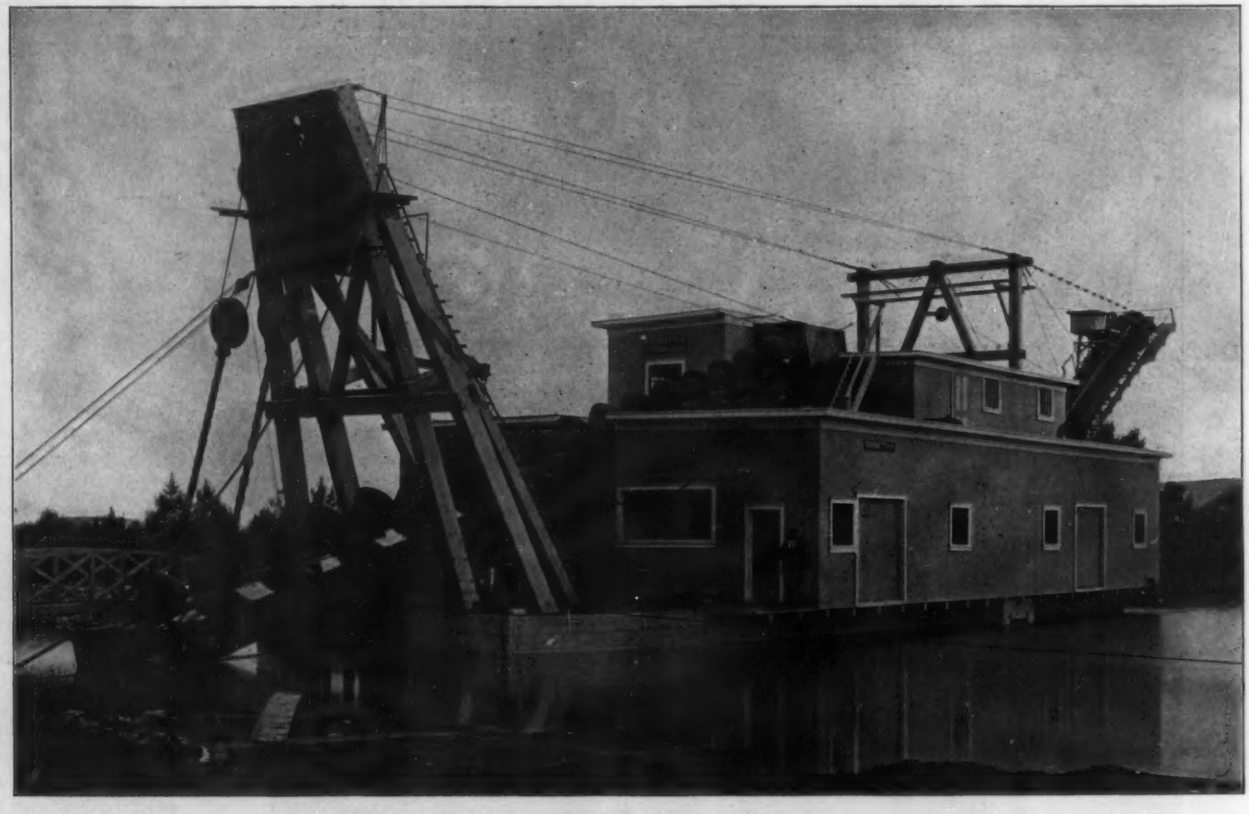
One of the latest dredges working in the Oroville district is known as the "Baggett No. 1," built by the Risdon Iron Works, and is situated about two and a half miles from Oroville, on the highest ground in that district. As a general thing, the higher the ground the harder, and in this case the ground is not only hard, but it is also cemented so much that it is found impossible to excavate the pit in which the hull of the dredge was built, without the aid of dynamite.

This dredge was erected and commenced operation, and for a time did heroic work in this very hard cemented gravel, but it has since been proven that it is more profitable to blast the ground in front of the dredge. This blasting is done by drilling holes six inches in diameter, with a drilling machine similar to that used for testing the ground, and going down some twenty feet (the ground in this case is thirty-five feet deep), and loading the hole with about eighty pounds of black powder, and firing in the usual manner. The holes are placed approximately twenty feet from the face,

and forty feet apart. This blasting costs in the neighborhood of two and a half (2½c) cents per cubic yard, which is more than offset by the increased capacity of the machine, to say nothing about saving the wear and tear.

This machine is of the usual Risdon design, with all of the latest improvements, having open type buckets of seven cubic feet capacity with revolving screen and bucket stacker. The hull is ninety-six feet long, thirty-four feet wide and seven feet deep, having rounded bows and rake-off at the stern. The hull is well reinforced by Howe trusses, which does away with the unsightly hogging rods, and has proved itself to be amply strong, when doing hard digging.

Hard digging is a poor description of the movements and strains that take place on the machine, and men, who are not accustomed to the work, are often made seasick; the writer has seen even Chinamen turn pale with the hull bouncing up and down two and three feet, as each bucket comes round the bottom tumbler.



Beginning at the front of the boat, we first notice an improvement in the hoisting arrangement, which consists of a steel head frame, on which are attached the hoisting gear, consisting of two drums keyed onto one shaft, and driven by a variable speed motor through two sets of gearing. This steel frame is supported on six heavy timbers, which are some 42 feet long, and secured to the hull by means of a steel foundation frame, in all making a very substantial job, but nevertheless none too rigid for the work it has to withstand.

The stern gantry is of the usual Risdon design, consisting of two vertical posts sixteen inches square, forty-two feet long, which are supported on a heavy steel gantry, extending completely across the hull, and in turn rest on four keelsons.

The tumbler on the center gantry is built of steel throughout, having two heavy girders extending completely across the hull, which support steel main channels and plating, and at the top of this are situated the main tumbler bearings, which are of cast steel and of a new design, embracing not only the top tumbler shaft, but also the hanger shaft on which the ladder is pivoted, together with the main counter-shafting, which carries the main pinion. The main ladder which hangs on the hanger shaft just mentioned is fitted with telescope or extension screws, which permit the distance between the top tumbler and the bottom tumbler to be decreased or increased to take up the stretch of the main bucket chain. This construction is only found in the Risdon dredge, but has time and again proved very useful, and saving a great deal of lost time, owing to the bucket chain stretching and becoming so loose that the chain leaves the bottom tumbler, while it is not slack enough to allow taking out a complete bucket. Thus the advantage of having telescope screws is very apparent. The only objection to the telescope screws has been the impossibility of getting the hanger shaft close to the top tumbler shaft, and this objection has been overcome by making the extension between the hanger shaft and the lower tumbler. By this method the hanger shaft is now placed within one-half inch of the outsides of the upper tumbler, and gives practically a straight lead to the bucket chain when working at various depths.

The main ladder is of the usual girder type, seventy-eight feet long, and five feet deep, plated on all four sides; the top and bottom having openings over which the ladder rollers are placed. These openings allow any spill to pass through and not collect on the ladder as in most designs, to say nothing about preventing the ladder rollers from revolving, and causing flats. The lower end of the main ladder is supported by two-inch chains and two single sheaves carrying plow-steel ropes one and one-half inches in diameter, one end being attached to the top of the steel frame of the bow gantry, passing down from the single sheave and back to the drum, which has turned grooves to exactly fit the rope. This hoisting arrangement is very simple and effective. There are no ropes stringing across the gantry at various angles, and guide sheaves are completely eliminated. Also the deck room in the operating house is very much increased and simplified.

The main buckets are of a very heavy design, having manganese and projectile steel lips. This was done for comparison, since in some ground it was found that projectile steel will last longer than the manganese, but in this particular case both lips seem to have about equal wearing value. The projectile steel does not cost over twelve cents per pound, while the manganese costs seventeen cents. The bucket chain and bushings are of forged manganese, which has proved to be superior to all other grades of steel.

The connecting links connecting the buckets together, are forged in one solid piece, thus making a bucket chain in which all risks of breakdown, due to faulty material, are eliminated. It is a well-known fact that it is impossible to get absolutely faultless castings, therefore the aim of the builders of this dredge is to use a material of absolute known quality. These forged steel connecting links, while costing more in the first place, will more than pay for themselves within a year or two, and have also approximately twice the wearing value of the cast-steel connecting links.

The gold-saving apparatus is of an entirely new design, which the builders have patented, and after going on board this dredge, one is struck with the quantity of deck room there is. The fine material, after leaving the revolving screen, falls onto a set of distributing plates, lined with riffles. These plates absolutely divide the material into two parts. Not only does it divide the quantity but also the quality. Thus, if a great deal of fine sand is passing into the revolving screen, it does not all go out on the one set of tables, but half is taken on one side, and half on the other. This is the first revolving screen to be fitted up in this manner, namely, to divide the material, both in quantity and quality, which is a very essential thing in gold saving.

But, to go back one step, the material after leaving the box at the top tumbler falls on to what is termed a rock-line chute, which has two distinct advantages. The first is that the material does not either stick to the chute, or slide at too great a velocity into the revolving screen, both of which are very undesirable. This is overcome by a very simple

arrangement; instead of making a chute of the usual design, a box is formed with a semi-circular outlet, and the material is dumped into this box until it will run out of its own accord. Thus the material falls on itself and saves the wear and tear of the old-style chute.

The top tumbler which drives the bucket chain consists of a sixteen and one-half inch square steel shaft, onto which are clamped wearing corners, and the old method of having a square cast-steel tumbler body keyed to a round shaft is done away with. This decided improvement, while being a little more costly, entirely eliminates shut-downs from the top tumbler getting loose on the shaft.

The bottom tumbler is of the usual design, having enclosed bearings and lubricated with grease—of such a design that it effectually prevents grit and dirt getting into the bearings.

The revolving screen to handle this hard cemented gravel is of the usual pattern, so constructed that all plates can be replaced without dismantling the screen. It is driven by friction rollers through a chain of gearing, and connected to an independent motor.

The washing device in the revolving screen is of the standard design, consisting of a number of nozzles, having a correct taper, which nozzles are strapped to a large pipe, and spray the water on to the material in the revolving screen in the form of heavy jets, instead of the spray design used on flat shaking screens. These heavy jets of water are very desirable when handling sticky and hard material, since it thoroughly disintegrates any clay, and allows the gold to be caught in the riffles.

At the stern of the dredge we find the usual Risdon stacker, and elevator, which consists of a continuous chain

of close-connected buckets, which has proved far superior to the rubber belt. This is becoming more marked every year, as the grade of rubber belt supplied is decreasing with the increased demand for rubber. The rubber belt, which would last twelve months, costing in the neighborhood of eleven hundred ($1100.00) dollars, will now not last half that time; in fact, a number of cases have occurred where the rubber belts have not lasted more than two and a half months, whereas the close-connected chain of stacker buckets, while not being so attractive to look at, will show a saving over the belt conveyor of forty per cent in up-keep, and thirty-five per cent less lost time, due to elevator repairs. There is also another advantage of the bucket stacker, and that is it will always carry the material whether wet or dry, whereas with the belt conveyor, should for some reason a little water pass through the screen on to the belt, the material will not be elevated, but will slide back, causing the dredge to shut down until this blockade has been raised. Nevertheless, some investors who see a brand new belt conveyor carrying a string of rocks silently and quickly up an incline of eighteen degrees, will prefer a belt conveyor, which have lower first costs than the reliable but absolutely certain chain of close-connected buckets.

The winches for manipulating this machine, together with the motors, centrifugal pumps, etc., are of the usual design, and do not call for any special remarks.

Cuts Nos. 1, 2 and 3 show various views of this dredge.

ELECTRIC EQUIPMENT FOR A WINERY.

The California Wine Association, which controls a large proportion of the California wine output, has purchased forty-seven acres near Point Richmond and is erecting an immense big plant which they call "Winehaven." The entire forty-seven acres will be covered with the manufacturing and storage buildings alone.

Electric power will be used largely throughout the plant for the various processes, and among others there will be six miles of switching track, with an electric locomotive. A 300-kilowatt engine installation is to be used with Westinghouse compound engines in the central power station.

The entire power equipment is so extensive and complete that Hunt, Mirk & Co., who have charge of the installation, estimate that it will take three years to complete it.

This enterprising firm also report the following turbine sales made by them. In view of the fact that the use of the turbine has only come into extensive use very recently, it speaks well, not only for the success of this type of prime mover, but also for the progressive spirit of the Pacific Coast.

The City Electric Co., of San Francisco, has purchased two 2,500-kilowatt, Westinghouse-Parsons turbo-generators, 11,000 volts. This company, representing the Fleishhacker interests, intends to enter the San Francisco field in a thorough way, as is evidenced by this order and by the further announcement that they intend to eventually increase the equipment by the addition of a 5,000-kilowatt unit.

The Los Angeles Gas & Electric Co. has purchased a 3,000-kilowatt unit, and the Gray's Harbor Ry. & Light Co. a 1,000-kilowatt set.

The entire January sale on steam turbines by the Westinghouse Machine Co. amounts to two units with an aggregated rated capacity of 25,000 kilowatts.

The Electric Storage Battery Company announces that they have opened a sales office at Atlanta, Ga. This office is located in rooms 1126-27 Candler Building, and is placed under the charge of Mr. Harold H. Seaman. Mr. Seaman was formerly engineer of the Cleveland sales office of this company, and his experience gained there will enable him to handle promptly all matters pertaining to the territory of Tennessee, North and South Carolina, Georgia, Florida, Alabama and Mississippi.

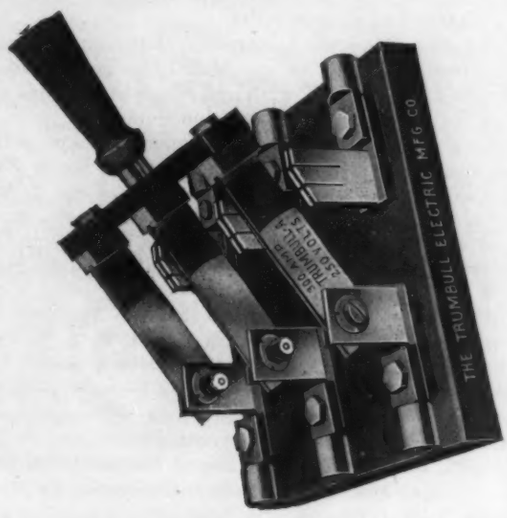
IS SWITCH MANUFACTURING A PRECARIOUS BUSINESS?

"The Manufacturing of Switches is a Precarious Business at Best" was the expressed opinion of a manufacturing expert who, having his ear to the ground, had noticed the rumbling and grumbling of late-moving days when so many small switch makers were forced to close up and larger manufacturers to cut out their switch line.

To quote another recent announcement, "Changes and rulings on the fusing of knife switches have been so many and have come so often in the last few years that a switch manufacturer, in order to supply the necessities of the trade, must go into the business in detail or find himself on the shelf. The increasing demand, also, for alternating current which requires an entirely different line of switches has added still further complications. The result is, that whereas a few years ago an assortment of a thousand switches was considered a good line, it requires to-day about thirty thousand different switches to constitute a complete line in any one style."

There is at least one glittering exception to these discouraging conditions, to wit, the Trumbull Electric Mfg. Co., of Plainville, Conn., who state that before long they are to publish their new catalogue which is to have the "precarious" distinction of showing the most complete line of switches ever published, requiring forty catalogue pages.

Trumbull's further announcement that about 45,000 separate switches are to be priced in this new catalogue does not stagger the unsusceptible mind so much when it is considered that every possible combination is to appear: front and back connected, quick break, double break, quick break and double break, fused and unfused, plain and polished, D C and A C—110-250-440 and 600 volts ranging from 15 to 2,500 amperes and covering in their respective classes both Type A (as shown in cut) and Type C switches. In fact, there is no knife switch which they cannot supply.



Their special department is said to be especially well equipped to turn out work in the shortest possible time. They add that this is true in part because they carry in stock more knife switch material than any one in the country. Customers are rarely kept waiting for lack of stock.

The design and workmanship of Trumbull switches certainly meet all the standards of a first-grade switch, if the careful conforming in all points of detail to the requirements of the Board of Underwriters and their approval of same, means a first-grade switch.

Their Type A switches go much further than this as recent tests in the Electrical Testing Laboratories of New York (noted authorities on electrical testing) show a resistance in rise of temperature of from twenty-five to fifty per cent below that allowed.

In the matter of construction special attention is given to the points of contact. Each switch is individually inspected by experts for that sole purpose.

When these facts are duly considered, as well as the substantial proportions of all material used, it does not seem surprising that Trumbull switches will carry a fifty per cent overload without injury.

This company advertises to make more individual switches than any other manufacturer in the country. Their Coast trade is very large. Not long ago they shipped a carload of switches to San Francisco.

In spite of contrary claims, the Trumbull people strongly deny that the manufacturing of switches is a "precarious business," providing, of course, that "the man knows how." As for themselves, they are to double their factory this year.

Their catalogue and literature will be freely supplied upon application.

NEWS NOTES

ELECTRIC RAILWAYS.

Boise, Ida.—The Boise & Interurban Electric Ry. Co. announces that its line between this place and Caldwell will be in operation by May 1.

Everett, Wash.—The Puget Sound, Skykomish & Eastern Ry. has applied to commissioners for franchise for an electric railroad and for telephone, telegraph, electric light and power lines. The electric road is to be built a distance of ten miles from Index to Galena.

Portland, Ore.—Actual construction work upon the United Railway Co.'s system is expected to begin in about ten days. L. B. Wickersham, constructing engineer.

Springfield, Ore.—Surveyor Klovdahl and crew are making a survey for the Willamette Valley Co.'s electric line from here up the McKenzie.

Seattle, Wash.—The Index & Northern Railroad Co. (capital $1,000,000) has been incorporated by C. F. Naething, of New York, John S. Jurey and T. E. Ellis, of this city. The object is to construct an electric line from Index to Mineral City, a distance of sixteen miles.

Boise, Ida.—New tracks throughout the entire length of the city trolley system on the Main, Thirteenth and Eastman Street line, and the Eighth and Ninth Street lines will be laid this Spring by the Boise Traction Company.

Bellingham, Wash.—Plans are under preparation by the special interurban railway committee of the South Bellingham Industrial Club, providing for a route of the interurban by way of Tenth Street to South Elk Street, where connection could be made with the Whatcom County Railway and Light Company system. The plans will be submitted to Stone & Webster, who will build the interurban this year.

Colfax, Wash.—It is reported that the Spokane Inland Electric Line are negotiating with the O. R. & N. Co. for their branch line, called the Moscow-Colfax branch.

Calgary, Alta.—Council has decided to build a municipal street railway system twelve miles long with equipment of twelve cars. W. L. Thorold, city engineer.

Everett, Wash.—The Puget Sound, Skykomish & Eastern Ry. Co., capital $500,000, has been incorporated by Nicholas Rudebeck, E. H. Guie and S. P. Ecki.

Helena, Mont.—Two hundred and forty thousand dollars has been subscribed toward the building of an electric line from Butte to Helena and thirteen miles beyond to the shores of Lake Hauser by F. A. Heinze, of Butte, and others.

Seattle, Wash.—A franchise for an electric railway to run around the shore line of the Duwamish River, commencing at Alki Point, and trestling bridges across the different waterways, has been granted to the Seattle Electric Co. by the King County board of commissioners.

Portland, Ore.—Articles of incorporation have been filed for the Mount Hood Ry. & Power Co., with a capital of $5,000,000, by E. P. Clark, R. T. Linney, S. B. Cobb and C. W. Miller.

Oakland, Cal.—A mortgage has been placed on record whereby the Oakland Traction Company mortgages to the Union Trust Company all its holdings, including real property, rolling stock, tracks and franchises. The mortgage is given to secure a bond issue of $12,000,000 which the trust company has underwritten. The bonds are to bear interest at the rate of five per cent., and are to run twenty-eight years. The Oakland Traction Company was incorporated November 7th last year, being a consolidation of the Traction Consolidated and other street railway companies. The Oakland Traction Consolidated had a bonded indebtedness of $7,000,000, which is taken up in the new issue. Much of the new debt will be used to extend the street railway system of the Oakland Traction Company.

POWER AND LIGHT PLANTS.

Calgary, Alta.—The proposition made by Messrs. Alexander & Budd to supply the city with electricity for power and light has been rejected and the city has made application to develop power at Kananaskis Falls.

Klamath Falls, Ore.—C. S. & R. S. Moore are planning to erect a large power plant on the Link River.

Oneida, Wash.—The Pacific Coast Gas & Oil Co., capital $300,000, has been incorporated by Alexander Sweek and Richard A. Wade, of Portland, Clayton L. Barber and John Nelson, of this place.

Tacoma, Wash.—Manager E. J. Felt, of the Pacific Traction Company, announced that his firm would, in a short time, begin the erection of a 40,000-horsepower electric plant in or near Tacoma.

Weiser, Ida.—The installation of a direct-connected or belted is contemplated for the municipal electric lighting plant. W. J. Morehead is superintendent.

Walla Wall, Wash.—The Board of Directors of the Northwestern Corporation, a company recently organized with a capital stock of $5,000,000, to control a score of light and power plants in the Northwest, met here and effected a temporary organization. Isaac W. Anderson, of Spokane, was elected president; Cary M. Rader, vice-president, and Robert Allen, secretary and treasurer.

Albany, Ore.—The Sanitam Electric Co. is arranging for the construction of seven power canals along the North Sanitam River. Joseph M. Healy, of Oregon City, is interested.

Ballard, Wash.—The Ballard Electrical Construction Co., capital, $2,000, has been incorporated by F. F. Fisher, R. L. Fisher and Alexander Bronk.

Portland, Ore.—The Portland General Electric Co. has been granted a franchise for a steam heating plant to cost about $300,000.

Portland, Ore.—A second power plant duplicating the Cazadero plant at Station A will be erected by the Portland Railway, Light & Power Co. on the upper Clackamas. The new plant will have a capacity of 25,000 horsepower.

TELEGRAPH AND TELEPHONES.

Spokane, Wash.—The Interstate Telephone Company, operating lines from Spokane into the Idaho panhandle, will extend its lines from St. Joe, at the head of navigation, twenty-five miles along the proposed route of the Milwaukee Railroad, and work will begin in a short time. M. A. Phelps, president of the company, said:

"It is the purpose to extend our service along the right of way of the new road, and we will begin work as soon as possible. We are now working on our new exchange at Coeur d'Alene, where the big switchboard is being installed. We are also stringing 5,000 feet of cable in Spokane."

Spokane, Wash.—A movement is being discussed at Colville, Wash., north of Spokane, to consolidate all the independent telephone lines in Stevens County, establish exchanges at Chewelah, Colville, Marcus and at Northport, extend short lines to contiguous points along the route of main lines and give an all-night or continuous service, and a rental rate to all subscribers to exclude any toll through the exchange. In exchange for the franchise privileges on the public highways, all county business will be handled free.

Spokane, Wash.—Stockholders of the Potlatch Farmers' Telephone Company, at Leland, decided at a recent meeting to connect with the Potlatch telephone line, of which R. H. Porter, of Juliaetta, Ida., is manager. This action is considered the most important move in the history of the company. The line has eighteen subscribers, but when the connection is made they will have communication with more than 150 farmers surrounding Juliaetta, Kendrick and Cameron, as well as with all long-distance points.

Spokane, Wash.—The council of St. Johns, Ore., south of Spokane, has granted a franchise to the Home Telephone Company for twenty-five years. The company will pay the city $5,000, at the rate of $200 annually, after the company installs its plant. It has eighteen months to put the line in operation. The other considerations are free telephones for the city, underground wires in the business section, and such other regulations as the city attorney insisted on for the protection of the city's interests. The petition for franchise by the Pacific States Telephone Company has not been considered.

Spokane, Wash.—W. F. Nobbins, of Wallace, Ida., east of Spokane, has entered suit in the district court there to recover $1,989.44 from the Rocky Mountain (Bell) Telephone Company for injuries sustained while stringing a line to Burke, June 2, 1905. It is set out in the complaint that he came into contact with a high-power line operated by the Washington Water Power Company, which was close to the telephone company's wires. He alleges the company agreed to pay him $3.25 a day while incapacitated, but did not pay more than $121. He asks $1,594.44 for wages and $390 for hospital expenses.

Bellevue, Ida.—The Bell Tel. Co. will erect a new exchange in the Spring.

Colville, Wash.—A movement is on foot to consolidate all the independent telephone lines in Stevens County, establishing exchanges at Chewelah, Colville, Marcus and at Northport.

Leland, Wash.—The Inter Farmers' Tel. Co. (capital $10,000) has been incorporated by J. H. Munn and William Bishop.

Moscow, Ida.—Thomas Elson, superintendent of construction of the Pacific States Tel. Co., is here making arrangements to install a new and up-to-date exchange.

Portland, Ore.—The Home Tel. Co. is laying pipes for underground lines on Grand Avenue.

Roseburg, Ore.—G. P. Mock, of the Pacific States Tel. Co., is here preparatory to installing a new central energy system. A complete cable system is also contemplated.

Spokane, Wash.—The Interstate Telephone Co., operating lines from Spokane into the Idaho panhandle, will extend its lines from St. Joe, at the head of navigation, twenty-five miles along the proposed route of the Milwaukee railroad, and work will begin in a short time. M. A. Phelps, president of the company.

St. Johns, Ore.—Council has granted a twenty-five-year franchise to the Home Tel. Co.

Phoenix, Ariz.—E. L. Bumpus, Arizona manager for the Pacific Wireless Telephone Co., states that the company will have stations in Phoenix, Tucson, Bisbee and Prescott within a year. The company owns its own manufacturing plants.

Oakland, Cal.—Electrician Babcock's request for an appropriation on $100 with which to buy cable, and $399 for labor and material in installing it, referred to City Council, with recommendation that it be granted.

Modesto, Cal.—W. H. Palmer has asked the Board of Supervisors for permission to erect a telephone line along the Dry Creek, and the Board has granted the petition, providing that poles be of sufficient height to keep wires above any road traffic.

INCORPORATIONS.

Sacramento.—Articles of incorporation of the Vallejo and Northern Railway Co. have been filed with Secretary of State Curry. This action has been expected for several weeks, as it has been persistently reported that such a company was to be formed for the purpose of constructing an electric line between Vallejo and Sacramento. It was known that Melville Dozier, Jr., of Oakland, headed the new corporation, but nothing definite as to his intentions has been known outside of rumor. The articles declare that the Vallejo and Northern Railway Co. is formed for the purpose of establishing a steam or electric line with Sacramento and Vallejo as the terminal points. The directors and projectors of the movement are: Melville Dozier, Jr., George S. Kakie, C. Francis Kinsey, and John C. Veitch, of Oakland, and T. T. C. Gregory, of Suisun. It is the intention of the company to begin its line at Woodland, run it thence in a general southwesterly direction to and through Winters, then south through Vacaville, and thence in the southwesterly direction to Napa Junction. Then beginning at a point between Vacaville and Fairfield, at or near the town of Cement, the line will run into Sacramento. The entire distance covered will be 105 miles. The capital stock is given as $2,500,000, of which $105,000 is already subscribed.

Los Angeles, Cal.—The Home Gas Company has been incorporated with a capital stock of $6,000,000 by W. S. Phipps of Pittsburg, Pa.; W. M. Hiatt, Edmund Mitchell, E. M. Selby, W. Z. McDonald, John Telfer, R. O'Neal, R. H. and E. B. Burton.

Los Angeles, Cal.—The National Electric Company has been incorporated with a capital stock of $25,000 by E. A. Tucker, I. V. Dempsey, H. E. and L. B. Yockey.

San Francisco.—The Wonder Water Co. has been incorporated with a capital stock of $1,000,000, by W. Dorn, W. A. Starr, J. T. Overburn, A. L. and R. Chickering.

San Francisco.—The Big Creek Light and Power Co. has been incorporated with a capital stock of $500,000, by Leo. H. Sussman, M. W. Pryor, Joe Hafer, Jr., Walter J. McLean and Jos. C. Love.

San Francisco.—The Ocean Shore and Eastern Railroad Co. has been incorporated with a capital stock of $3,000,000, subscribed $20,000, by J. D. Harvey, J. A. Folger, Charles Carpy, C. C. Moore and Burke Corbett.

Fresno.—The Coalinga Enterprise Oil Co. has been incorporated with a capital stock of $300,000, by T. A. O'Connell, S. A. Guiberson, Jr., S. R. Bowen, R. W. Dalles, and J. F. Lucey.

Sierra Madre.—The Home Telephone and Telegraph Co., of Sierra Madre, has been incorporated with a capital stock of $50,000, by Charles Kersting, W. E. Ferman, F. M. Hawes, H. Iver Thomas and J. M. Baldwin.

TRANSPORTATION.

Sacramento.—Attorney Arthur L. Seymour, representing the Northern Electric Railway Co., has filed suit in the Yolo County courts at Woodland seeking to condemn a strip of land belonging to Abbie B. Reed, containing 144.36 acres, and being situated along the Sacramento River, on the Yolo side, beginning at a point opposite a point between M and N streets, and extending thence along the river to a point nearly opposite a point between O and P streets. The Northern Electric Co. wishes to acquire the land on which to establish the terminals and yards of the new road, which will enter Sacramento in the near future, on 18th street, and will run to 7th and K streets, via D, 15th, I and 7th streets.

Redlands.—Following a meeting of persons interested in the Chestnut and Dunn electric railway franchises recently purchased from the city for eleven miles of street railway on Colton, State, Sixth, Citrus, and Reservoir streets, a temporary organization of the Redlands and Yucaipe Electric Railway Co. was effected, capitalization being placed at $1,000,000. C. S. Chestnut, George H. Dunn, O. D. Collins, O. M. Miller, and A. A. Moore are named as directors and incorporators, and have subscribed $18,000 of the capital stock. Articles of incorporation were filed at San Bernardino. The promoters claim that several persons of financial ability are interested and that the road will be built if the right of way is given free by ranchers in the valley. This has been promised, but deeds have not been given and cannot be until a survey is completed. This will require two weeks, and possibly longer, on account of snow. President Chestnut said that the route has not been definitely selected over the hills south of Redlands, but it is believed that the road will go out Reservoir street and through the canyon to the Yucaipe bench lands and thence on a direct line to the Oak Glen mountain resort, eighteen miles from Redlands.

Stockton.—Colonel W. R. Johnson, of the Central California Traction Co. and the American River Electric Co., says: "We expect to be running interurban cars into Lodi by April 1st." The two companies are separate corporations, but the majority of the stockholders in each are the same men and the same men are officials in each company. Colonel Johnson stated that the rails and ties for the road from this city to Lodi are on the ground and that the cars will be here before April 1st. Lewis Moreing has been awarded the contract for doing all of the grading and concrete work. The new cars for the company are practically finished. Several of them are ready for shipment, and the remainder are in the paint shops. All will arrive before April 1st, and it will require but a few days to mount them on their trucks and motors. Five of the cars will be for use in Stockton alone, and will be duplicates of the cars now used by the company in this city. There will be four passenger coaches. In addition to them there will be a number of freight cars, combination baggage, express and smoking and motor cars to haul the freight trains.

Santa Cruz.—The Ocean Shore Railway surveyors are in Soquel mapping out the route for a continuation of the line that is to connect Soquel with San Francisco, nearby towns and the San Joaquin Valley.

San Jose.—As the culmination of a series of complaints from merchants, citizens and various local organizations, the Mayor and City Council have notified George L. Berker, manager of the San Jose Street Railway Co., that unless summary action is taken by the company to rehabilitate its entire system, steps will be taken to revoke its franchise. The railroad company is owned by the Germania Bank and Trust Co., of San Francisco. An effort was made by L. E. Hanchette, of San Francisco, some weeks ago to purchase the line for $500,000, but the offer was rejected, the company holding out for $750,000. The claim is made that the company is holding up the city in the hope of securing a large price for the property. Hanchette has applied for franchises paralleling all of its tracks.

Alameda.—A representative of F. M. Greenwood has announced that Greenwood would start work on his proposed electric line through Alameda inside of two weeks. For several days Greenwood's agents have been taking up old options and securing new ones. At one time, after the fire, it was quite generally believed that Greenwood would abandon his franchise, but it is now announced that the road will be built.

TRANSMISSION.

Yreka.—By coupling its old power plant at Fall Creek with its new plant on Shasta River, the Siskiyou Power Co. established an interchangeable system, and can send out power from either or both sources. The Fall Creek plant produces 26,000 volts, and the Shasta River plant 6,500 volts.

San Francisco.—The Monterey County Gas and Electric Co., which owns and operates the electric car lines running from the Hotel del Monte to Pacific Grove, through Monterey, is remodeling its electric power plant at Monterey. It is now in the market for a 1,500-kilowatt turbo-generator to supply the increased power that will be needed when the electric road is extended to Salinas. George Heazelton, Kohl Building, San Francisco, is one of the new owners. He says the company has no connection with the projected Monterey, Fresno and Eastern Railway.

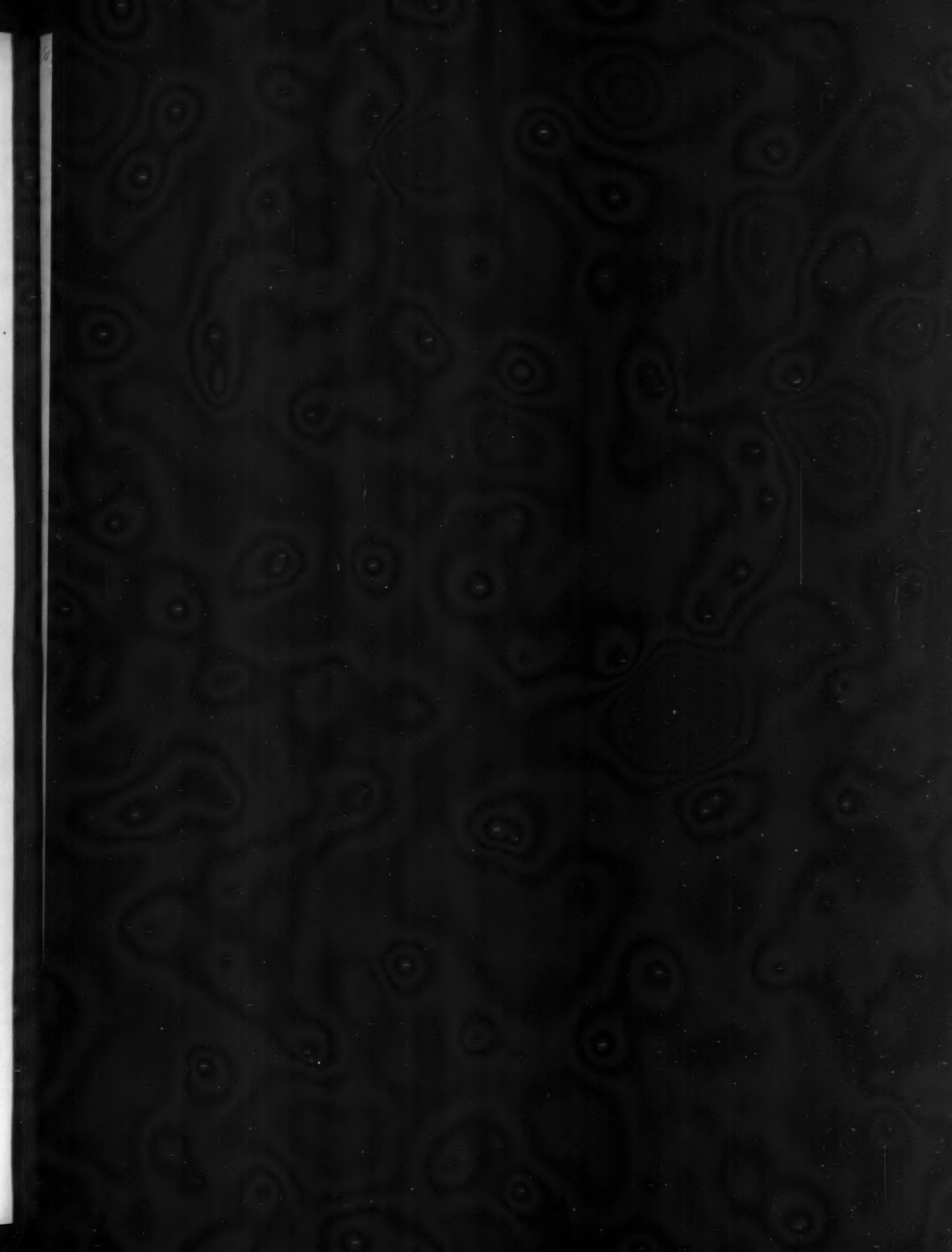
WATER WORKS.

San Francisco.—Sealed bids will be received at office of Construction Quartermaster, 1080 North Point street, San Francisco, until 11 a. m., March 16th, for furnishing all material and labor and constructing a water distributing system, sewer system and a 200,000-gallon reinforced concrete reservoir at Fort Berry, Cal.

Yuba City.—C. B. Andros, proprietor of the Yuba City Water Works, has purchased from Mrs. A. E. Davis a lot in the Copper Tract facing Bridge street, and located just south of the site of the proposed depot for the Northern Electric. Mr. Andros will take steps at once to sink wells to supply water for his big standpipe tanks, which he will erect on the lot.

ILLUMINATION.

Lakeport.—M. Wambold, of the Lake County Paraffine Oil and Gas Co., reports that a strong flow of natural gas has been developed in the new well which he is sinking for the company, much stronger than any which he has encountered heretofore. The well is perfectly dry, and the flow of gas surpasses in quality and quantity anything developed previously. Already the company has developed sufficient gas to get up steam for a standard rig. As soon as well No. 2 is completed a third well will go down, and then the three will be connected and the gas confined to one feed pipe.

Fresno, Cal.—The Western Gas and Power Co., of Oakland, submitted an offer of installing a complete gas plant at the county hospital and the almshouse for $1,465.50, at a meeting held recently by the Board of Supervisors. J. H. Becker, manager of the Western Gas and Power Co., and M. P. Holland, representative of the company in this city, presented the proposition of installing of a gas plant at the county hospital and almshouse. They offered to install a 1,000-light gas generator, with capacity of 4,000 cubic feet of gas per hour, complete for $1,000 on a trial of thirty days. This includes all the necessary labor and material connected with the plant. The company also agreed for $465.50 extra, to install necessary 50-candle power lights, an 8-R. W. Rood automatic water heater, 3 gas plates, all the necessary mains running into the hospital and almshouse. The proposition of the company was referred to the hospital committee for report at next meeting.

Redlands.—T. H. Sharless has moved to Perris from Redlands, and is at present working on a plan for a stock company to install an electric light plant and modern water system.